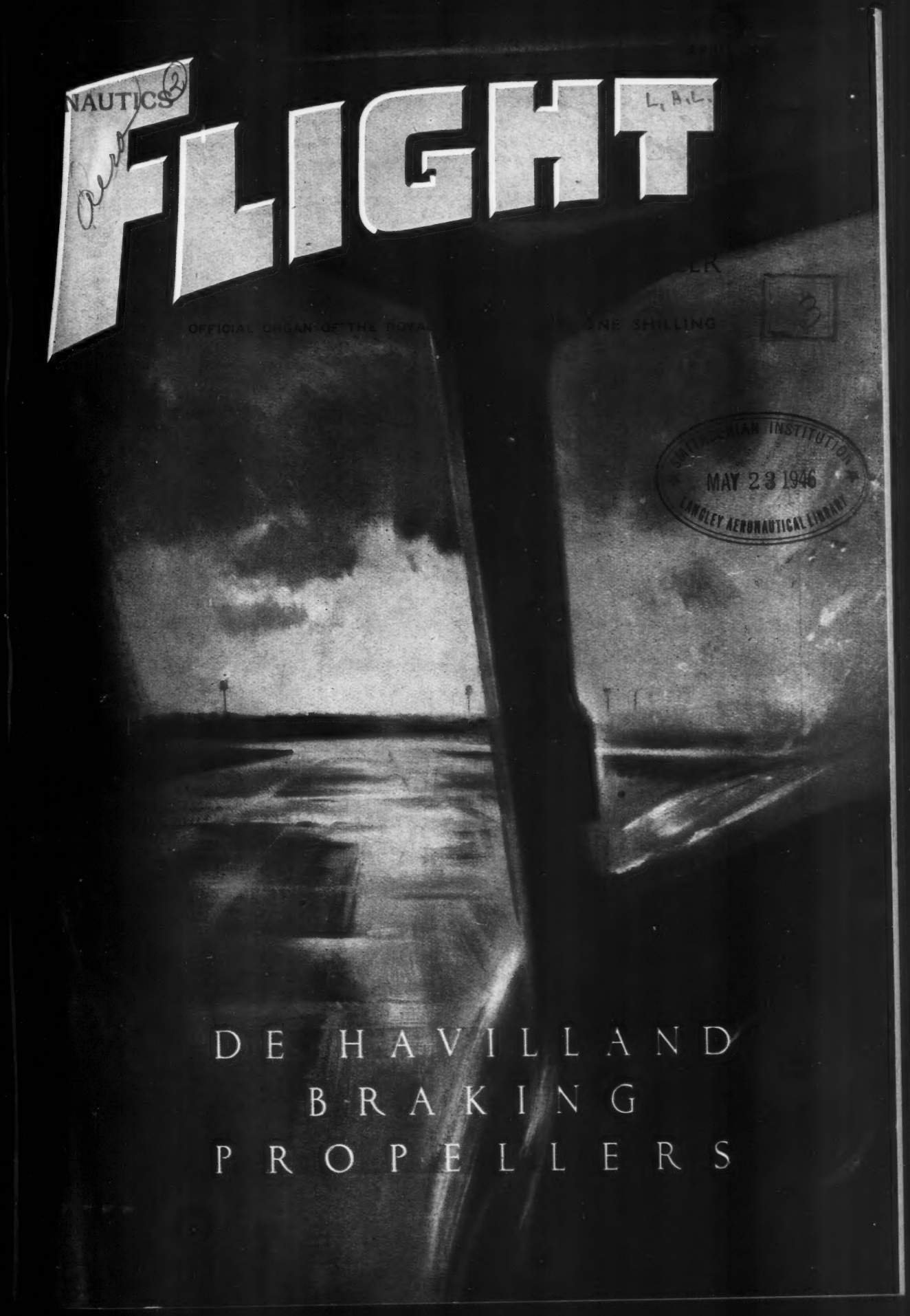
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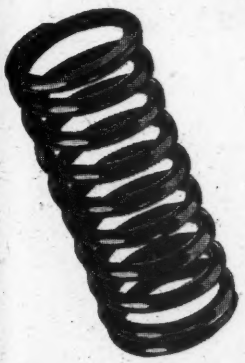

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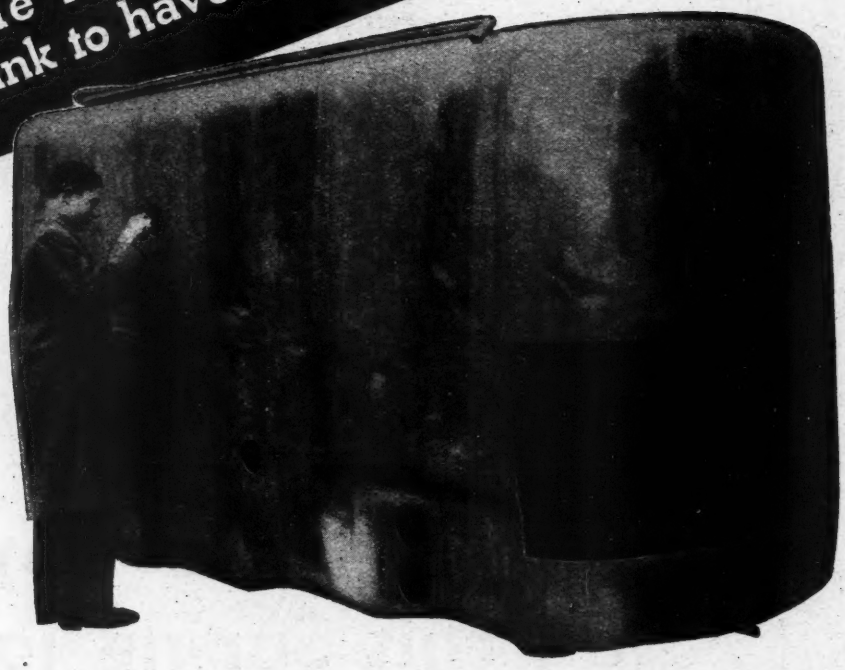

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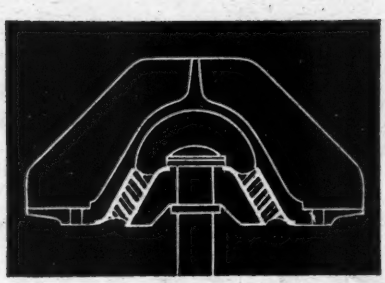

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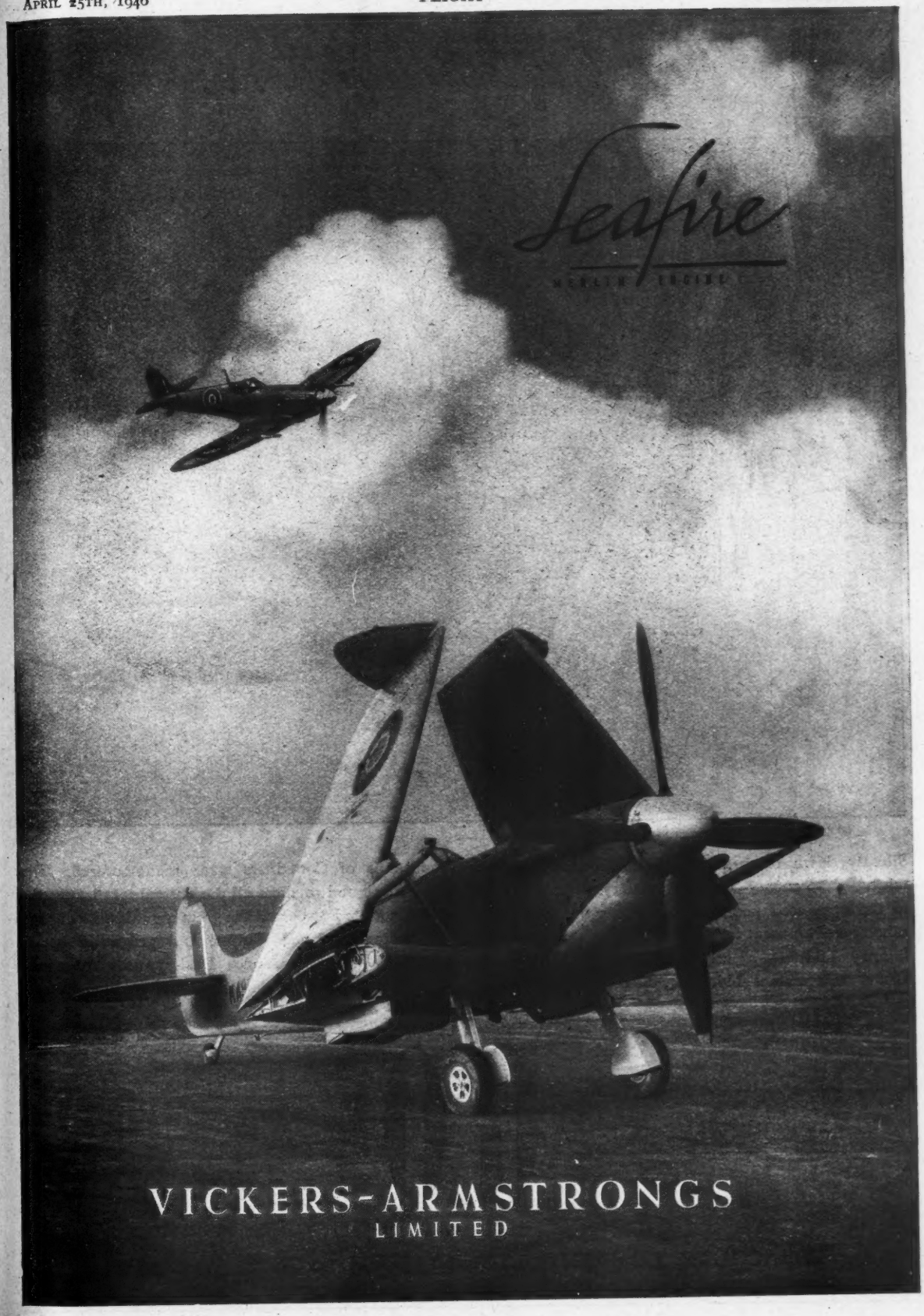
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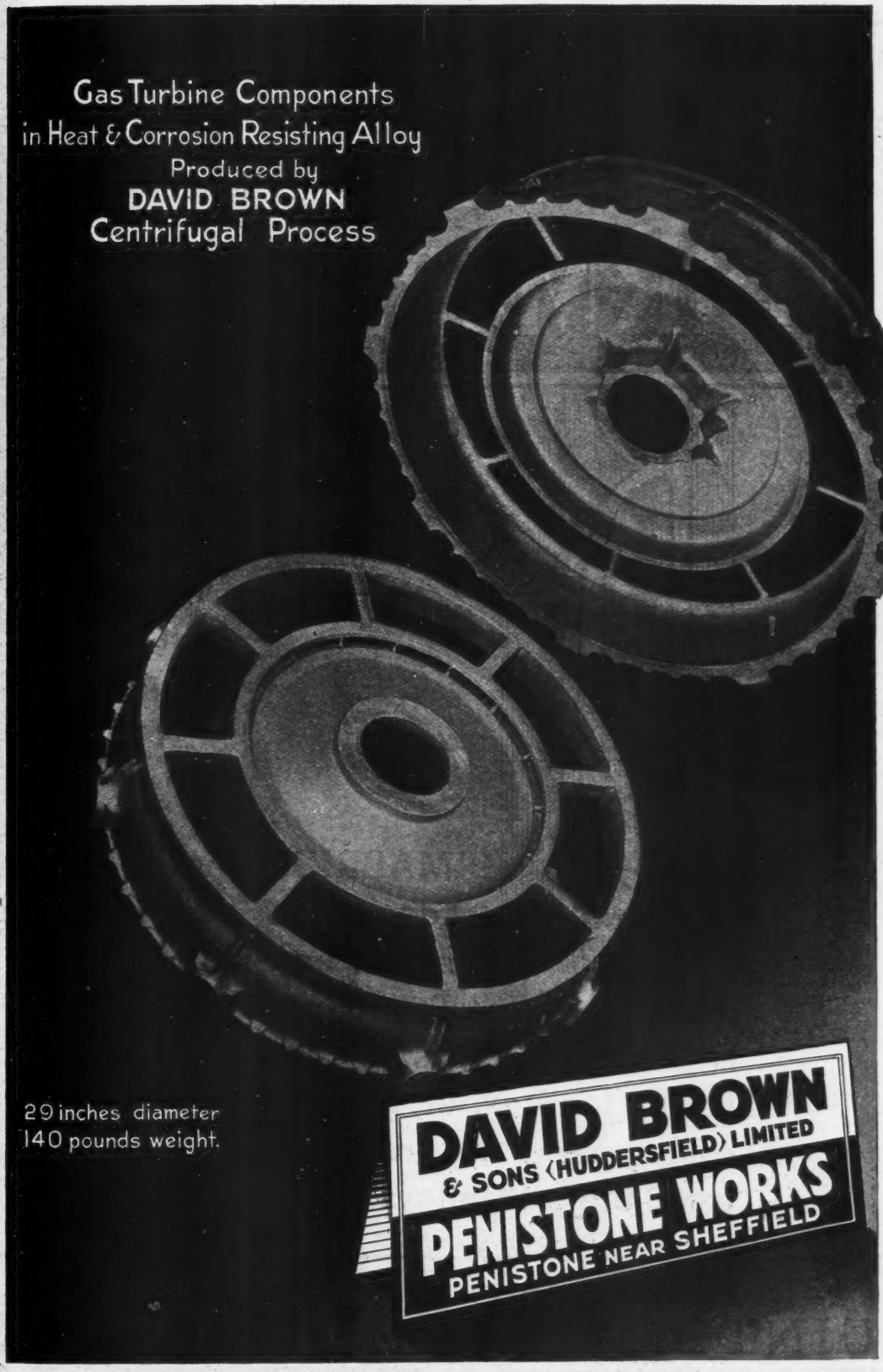
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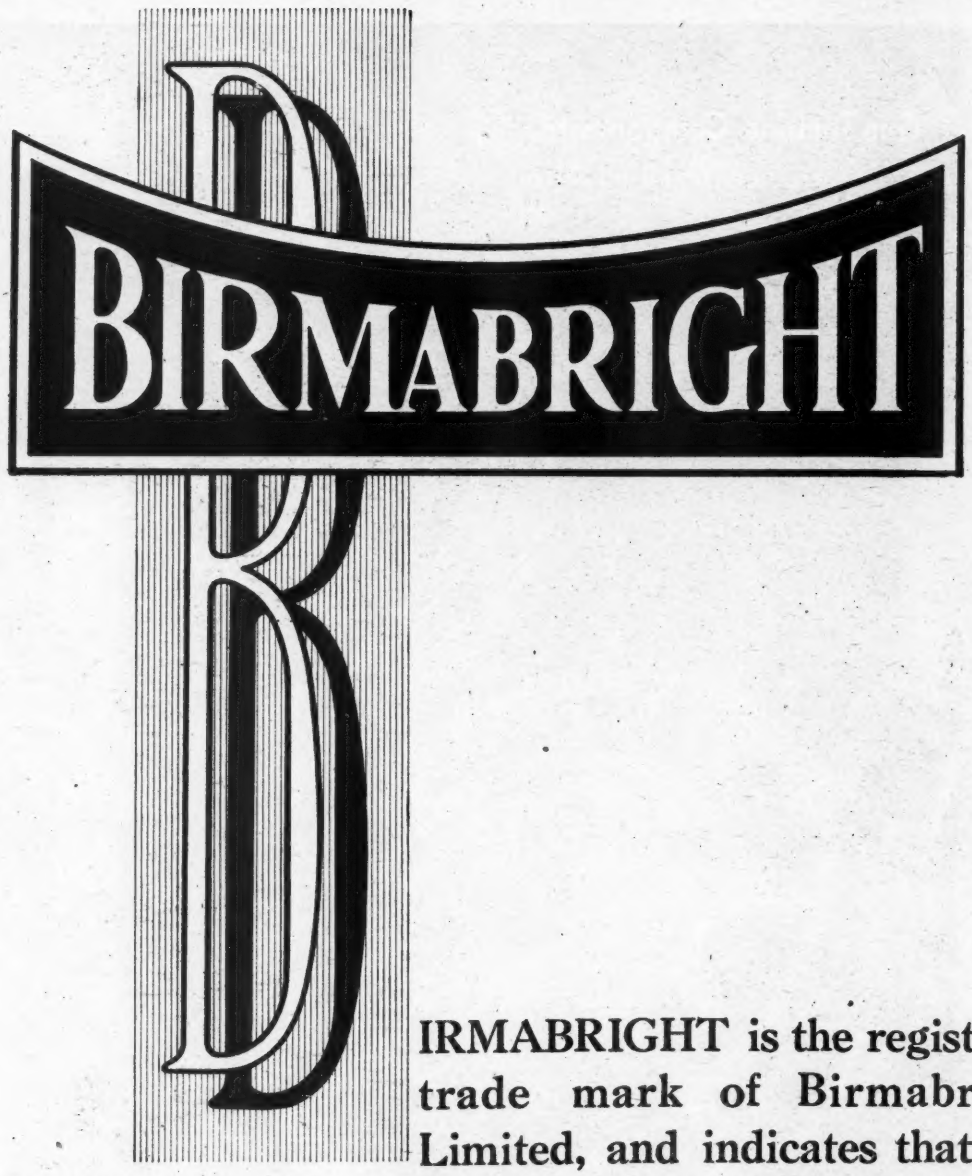

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13/16"	"	4 or 5	1.300"
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15/16"	"	5	1.480"
1"	"	5	1.670"

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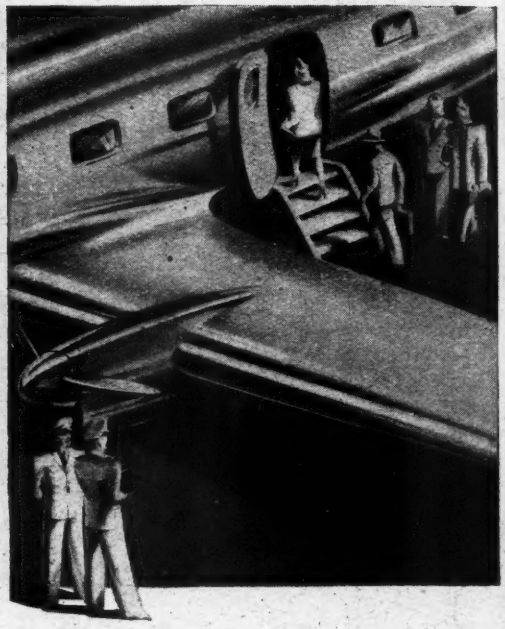

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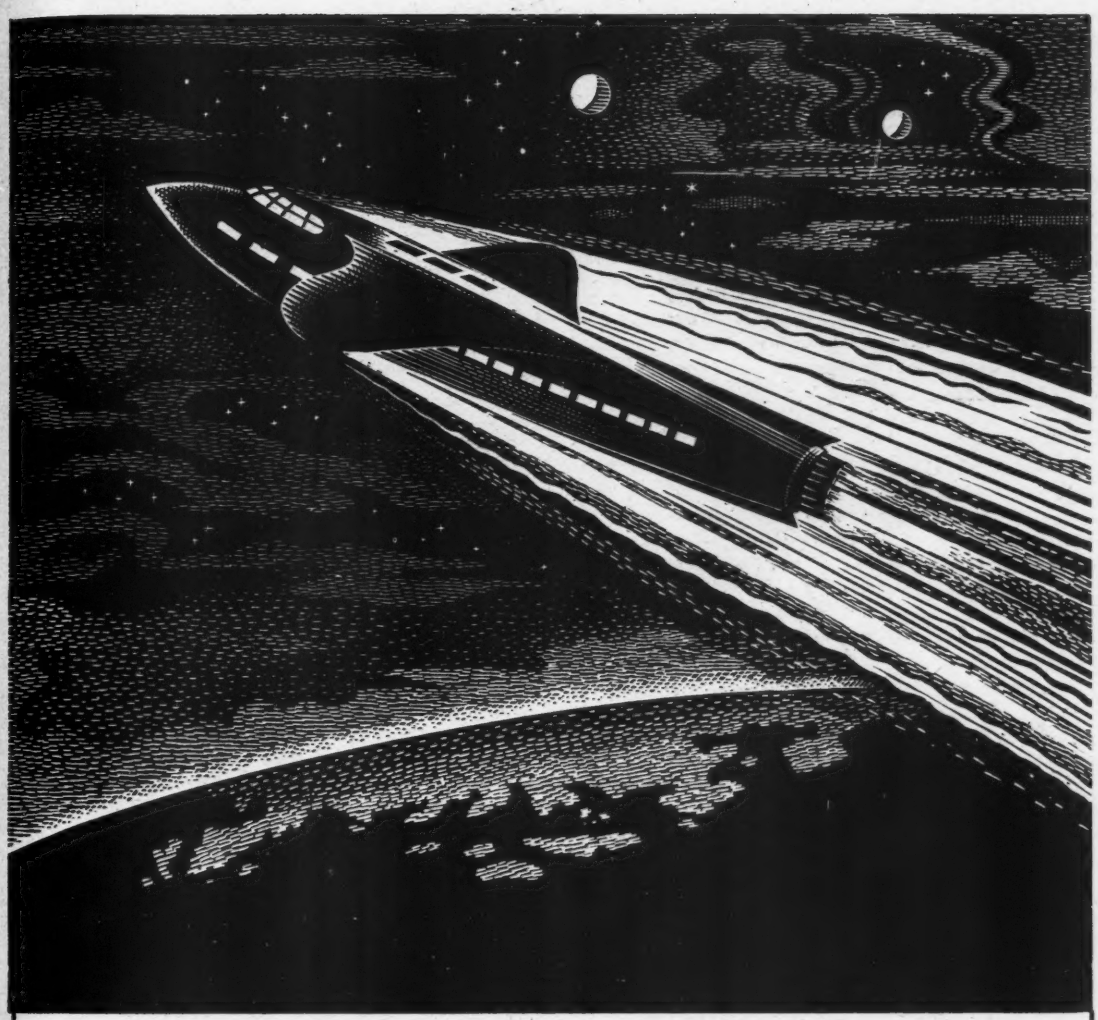

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The Outlook

A Floating Museum?

IN a very few years' time we shall hear from thousands of youthful lips the question which became so familiar to pilots of the R.F.C., R.A.F. and R.N.A.S. after the last war: "What did you fly in the war, daddy?" Old copies of *Flight* will provide the answers in a great many cases, but even our photographs and sectioned drawings cannot compare with seeing the "real thing"

Lately our Correspondence pages have contained the suggestion that one of the old aircraft carriers, *Furious* or *Argus*, might be converted into a museum for Naval Air Arm equipment. This week a correspondent supports the suggestion and pleads for R.A.F. material to be included as well.

On the face of it the suggestion is attractive. When stripped of some of its wartime equipment, a carrier could provide a good deal of space, apart from its flight deck, and possibly the deck itself could be roofed-over if ballast were added to keep the carrier the right way up! They look sufficiently top-heavy in their normal guise without any additional top hamper.

We are not, of course, forgetting the old-timers at South Kensington, but Naval aviation is not well represented there, and there would be something rather appropriate in having a floating home for historic Fleet Air Arm types (aircraft, not men!). It may well be, however, that the upkeep cost of a carrier would be greater than could well be tolerated.

Then there is the question of a suitable mooring site. The Thames is fairly well out of the question since the site would have to be below the bridges, and probably a long way below on account of the docks. A very fitting alternative location would be at Portsmouth, near Nelson's *Victory*, where the carrier would be a constant reminder of the Navy's somewhat tardy conversion to airmindedness.

Best of all it would be if a carrier could be converted into a perambulating museum, going on visits to our own ports and, possibly, even to places abroad. There would be precedence for such a course in that some years before the war a carrier was sent to South America with an exhibition of British aircraft material. A cruise of this nature now should give a useful fillip to aircraft exports.

Looking Ahead

THE recent visit by Lord Winster and Sir Henry Self to Portsmouth to discuss the possibilities of establishing a flying-boat base in Langstone Harbour shows that the Minister of Civil Aviation is well aware that the Government's responsibilities do not end with the ordering of three large six-engine Saunders-Roe flying-boats. Before these can be put into regular operation it will be necessary to have suitable terminal facilities for them.

It is one of the advantages of large flying boats that they do not require the elaborate preparations which will be necessary for their landplane counterparts of the future. But on the other hand, it would be very short-sighted policy to deny them a certain measure of land-based aid at their termini. The flying-boat has suffered all its life from neglect in this respect. Because it is able to operate with but the crudest terminal facilities, it has been condemned to doing so. To make the best possible use of its good qualities, it must not be allowed to work under this handicap in the future, and consequently Lord Winster's visit is to be welcomed. Langstone Harbour may or may not be the location ultimately chosen (although it would have the great advantage, among any others it may possess, of being within easy distance of the Saunders-Roe works at Cowes). What matters at the moment is that the Minister of Civil Aviation is following up his placing of the order for the flying boats by a survey of possible terminals for them. Doubtless he will visit other sites before a final choice is made.

Helicopter Development

THE recent official announcement that three British firms are engaged in developing the helicopter type of aircraft was a welcome indication that this country does not intend to be left behind in this promising field.

Before the war several nations were experimenting, with varying degrees of success, and Germany got ahead of the rest, at least to the extent of establishing world's records for speed and height with the Focke-Wulf machine. In Europe France, Belgium, Holland and Great Britain were at work, but not in any very determined way so far as the governments were concerned.

In the United States Igor Sikorsky reverted to his "first love," the helicopter, and by 1941 he had progressed sufficiently far to beat the German records. Since that time much has been heard of the Sikorsky series of helicopters, and early this year all previous records were beaten by handsome margins with Sikorsky helicopters of the R-5 type. The speed was raised to 114 miles per hour, the maximum altitude to 21,000ft, and a height of 16,000ft carrying a payload of 1,100lb. The "unofficial" record of lifting 18 people need not be taken too seriously, since ground effect is somewhat pronounced and the machine would not have climbed very high, but it was a spectacular achievement.

In this country the work has been going on behind closed doors, but it *has* been going on. The three firms to which the official statement obviously referred are the Cierva Autogiro Company, the Bristol Aeroplane Company, and the Fairey Aviation Company. Of the three, the Cierva concern has obviously had the longest experience, since its roots go down to the days, twenty years ago or so, when Señor de la Cierva first brought his very crude Autogiro to this country. Some of the work done by that firm in the way of helicopter development was outlined in a series of articles which we published a couple of years ago. Much has been done since, of which it may become possible to write in the near future.

The Bristol Aeroplane Company secured the services of Mr. Raoul Hafner some years ago, and his experience dates back to well before the outbreak of war, when he produced his very successful jump-start gyroplane and followed it up with helicopter projects which had to be shelved on the outbreak of war. Pictures of a model of one type of Hafner-Bristol helicopter have been published, but otherwise little information has been divulged.

Most recent recruit to the field is the Fairey company, but as several rotating-wing experts have joined the firm recently, it may be expected that progress will be fairly rapid.

Altogether the prospects of this country being able to make-up the leeway of the last few years are not discouraging. Already there are rumours of useful loads being expressed in tons instead of pounds. As for the form which the helicopter will ultimately take, many combinations are possible. It seems likely, however, that in the small class the single-rotor system will become popular. Anti-torque devices may be the small airscrew, as used on the Sikorsky, or possibly a jet, as patented by the Cierva firm. In the large class probably two main rotors will be used.

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"DUMBO." The Supermarine Type 322 has a variable-incidence wing, here seen in the high-speed position. On the opposite page it is seen with the wing at maximum incidence and flaps down.

Variable Incidence

The Supermarine 322 flying with the wing at a large angle and the flaps down.

Ancient Device in Super-modern Form Applied with Success to Supermarine Type 322

THE history of flying has many instances of ideas and devices being tried out by the pioneers, some being adopted and surviving, others being abandoned after brief trials, either on account of basic defects or because the materials necessary to make them a success were not available in those days.

It is difficult to say with any certainty who first thought of attaching the wings of an aircraft in such a way that the angle of incidence could be varied in flight. Several attempts were made, some varying the incidence and camber simultaneously, others using a rigid wing section and changing the incidence only. The difficulties were considerable, especially in view of the somewhat crude state of the art of aircraft design which was all that had been reached at that time.

To the best of our recollection, the first variable-incidence machine to fly successfully was the French Paul Schmitt biplane exhibited at the Paris Aero Show of 1913. During 1914 the Paul Schmitt established world's altitude records carrying six, seven, eight and nine passengers, so it must be assumed to have been a fairly good aircraft. One would not, however, like to claim that it could not have established the same records if its wings had been fixed. It probably could have done so. But at least the mechanics and aerodynamics of the scheme must have been satisfactory.

Stationary Centre of Pressure

The biplane wings of the Paul Schmitt were carried on two bearings in brackets rising from the top longerons of the fuselage. The lower plane passed right under the fuselage without being attached to it, and the pivot point was approximately one-third of the gap from the upper wing. Thus when the incidence was increased (by a hand-

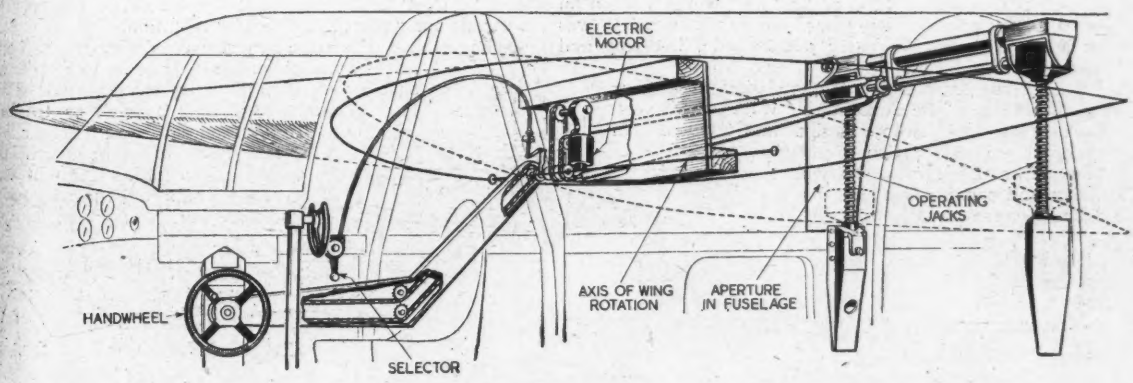
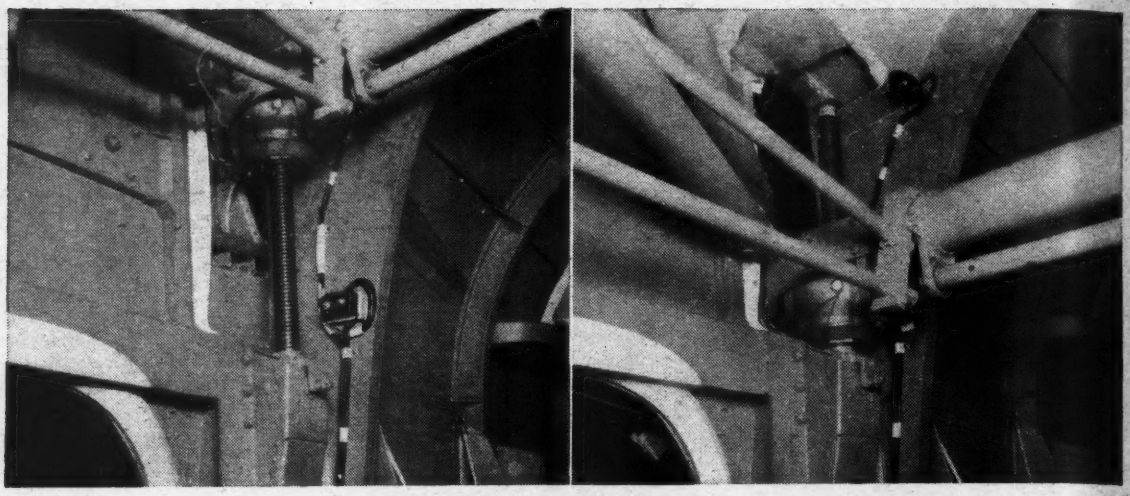


Diagram of incidence gear on Supermarine 322. Alternative hand and electric operation is provided



A screw jack on each side joins the rear spar to the fuselage. The tubular structure provides drag and torsion bracing. The two views show the wing at normal and maximum incidence.

wheel and worm gear), the lower wing moved forward a greater distance than the upper wing moved aft. This kept the centre of pressure of the complete wing cellule approximately stationary.

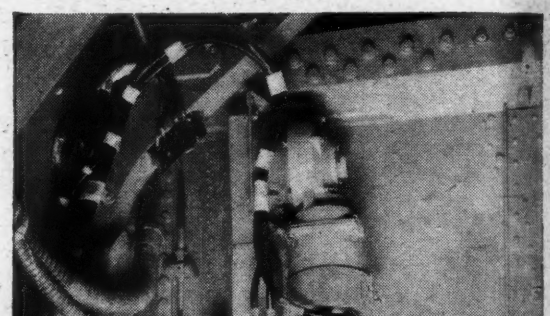
It may well be argued that for an aircraft of this type the advantage of variable incidence was too small to be worth while. It was so much simpler merely to tilt the whole aircraft by means of the elevator, and it was possibly for this reason that the scheme did not survive.

VARIABLE INCIDENCE (CONT.)

There are, however, cases in which the variable-incidence wing is well worth its extra weight and complication. The flying boat could be quoted as one. With a variable incidence the hull could be kept at its best angle for take-off and the wing angle changed to suit the conditions during the take-off run. Similarly, when landing it would be possible to set the wings at maximum incidence for the final touch-down, which could then be made with the hull at the most favourable attitude. In this way any tendency towards bouncing off the water could probably be avoided, or at least reduced to small proportions.

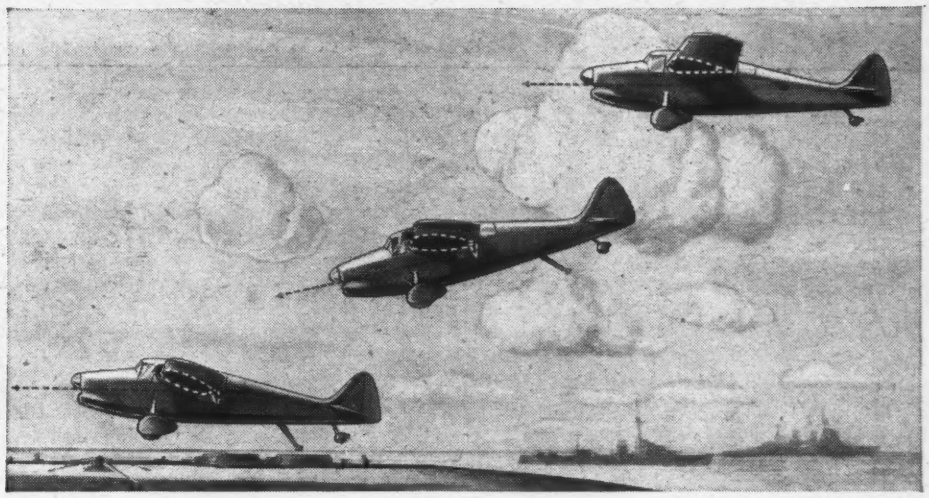
Even on landplanes there may be operational conditions which make a variable-incidence wing desirable. For example, where space is very limited, as on a carrier, it is essential to give the pilot the best possible view forward over his engine. With fixed incidence the nose comes up just at the critical moment and blots out a very large arc of view. This was realised as long ago as 1937, when an Air Ministry specification (S.24/37) was issued. It was for a naval aircraft to carry out torpedo, bombing and reconnaissance duties.

Among the firms which tendered designs to that specification was the Supermarine works of Vickers-Armstrongs, Ltd., whose design was adopted and an order placed for two prototypes. The outbreak of war delayed the design and construction, but by 1943 it had become possible to begin flight trials, and some extremely interesting and very promising results were obtained. The second prototype was completed some time ago, and although the machines will not now be used for their original purpose, they are proving valuable for research and experimentation.



The electric motor on the front wing spar which provides an alternative to hand operation of the incidence gear.

The problem which the Supermarine designers set themselves was a difficult one. In order to keep down size, a very high-lift wing was essential. That meant leading-edge slots as well as trailing-edge flaps. In addition, since the machine was intended for carrier operation, the wings had to fold. It might well have been expected that the result would be both heavy and compli-



(Right) The 322 in normal flight with wing at small incidence and flaps up.

(Centre) Approach to land, with wing at maximum incidence and flaps down. The pilot's view is excellent.

(Bottom) Even when the tail is dropped for the touch-down, the view is good owing to the small ground angle of the fuselage.

cated. Actually the extra weight of the incidence gear did not turn out to be anything to worry about, and the complication is certainly less than one would expect. If the variable-incidence feature were to be used in an aircraft without wing folding, its extra weight might well prove almost negligible.

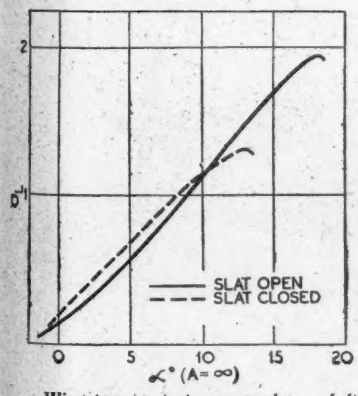
Fixed Undercarriage

What may be considered a fundamental disadvantage of variable incidence is that it precludes, for all practical purposes, the use of an undercarriage which retracts into the wings, and retraction into the fuselage is scarcely less difficult. For the purpose of the Air Ministry's S.24/37 specification, however, extreme performance was of less importance than other features, and a fixed undercarriage was adopted for the Supermarine 322. The high-wing layout was chosen as being the simplest for a variable-incidence wing, and this had the further advantage of giving the crew a good view downwards. So the machine saw life as a high-wing fixed-undercarriage monoplane of quite orthodox lines and of remarkably small size, considering the loads that had to be carried. The engine is a Rolls-Royce Merlin XXXII, which drives a Rotol four-bladed airscrew with compressed-wood blades.

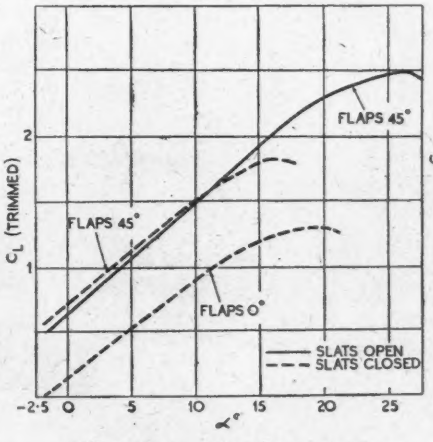
The variable-incidence gear is really very simple. It is shown diagrammatically in one of the illustrations. The wing pivots on the front spar, and the incidence is changed by two screw jacks connecting the rear spar to the fuselage. The jacks are operated via a chain drive either by a handwheel or by an electric motor, a control selector being provided for changing from one method of operation to the other. Normally the wing is set at 0 deg. to the fuselage datum line, and the incidence in the fully-down position is 13 deg., giving a maximum ground angle of 15 deg. as the ground angle of the datum line is 2 deg.

When the 322 was being designed it was decided to use mainly wood construction, as this would be quicker for prototype production, and light alloys were at that time in short supply. The fuselage has four spruce longerons, the frames are of spruce and plywood, and the covering is plywood laid on in diagonal strips.

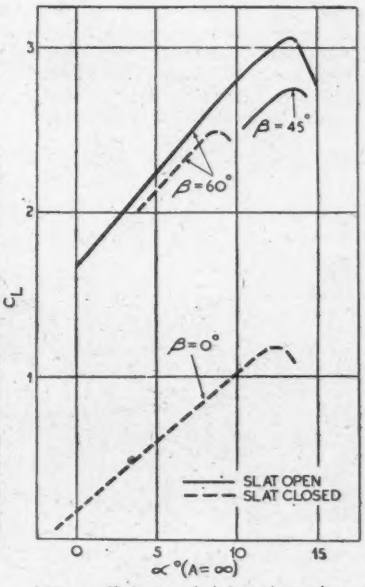
The two-spar wing is of composite construction, with front spar booms of L.40 light alloy and webs of 8-gauge D.T.D.390. The ribs are of spruce, spaced 12 in. apart, and the covering is plywood in the first prototype, alclad in the second. Control surfaces are plywood covered. An interesting feature of the tailplane is that it has no spars, the structure being a shell composed of spruce ribs and diagonal planking. The weight turned out at 2.57 pounds per square foot, for a factored loading of 93 lb/sq ft.



Wind-tunnel test on model. Lift coefficients of outboard section at Reynolds Number of 1.5 × 10⁶.

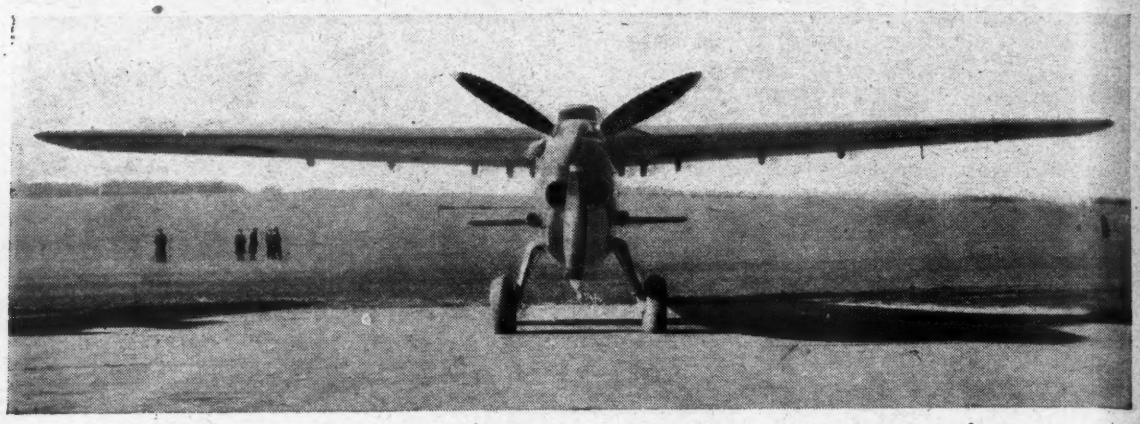


Lift coefficient at high-speed wing setting. V = 121.6 ft/sec; R.N. = 0.822 × 10⁶.



Lift coefficients of inboard section. Reynolds Number = 1.5 × 10⁶. The model tests were made at the R.A.E.

VARIABLE INCIDENCE



The clean appearance of the Supermarine 322 is well illustrated in this front view. The fixed, semi-cantilever undercarriage is of narrow track.

Two fuel tanks, each of 65 gallons capacity, form the nose portion of the wing centre section. They are made of alclad, and the inner leading-edge slats are supported on brackets bolted to the ends of the tanks. In spite of the varying loads to which they are subjected, and the high torsional loads which are applied when the wings are folded, the de Bergue riveted joints have remained petrol-tight throughout.

The semi-cantilever undercarriage has Vickers oleo struts carrying Dunlop wheels. The wheel track is 6 ft 4 in, which appears somewhat small for a high-wing monoplane of 50 ft span. The tailwheel is a Palmer Cord carried on a Vickers strut.

Control and Stability

Reference has been made to the use of a slotted and flapped wing to get a high maximum lift coefficient. When combined with variable incidence this was likely to present some aerodynamic problems, and wind-tunnel tests were made at the Royal Aircraft Establishment, Farnborough, on two constant-chord models which represented two spanwise stations. To get the high lift aimed at it was decided to use full-span slots and part-span slotted flaps. In order to make sure of avoiding tip stalling, the slat of the outer slot was so arranged that the stall occurred four degrees later than the stall behind the inboard slats. Originally the prototype was fitted with plain ailerons, but it was found that they did not enable full use to be made of the very high maximum lift coefficient (3.9 engine-on in the full-size machine), and slotted ailerons have now been fitted instead, with good results.

SUPERMARINE TYPE 322
ROLLS-ROYCE MERLIN XXXII

Dimensions and Areas

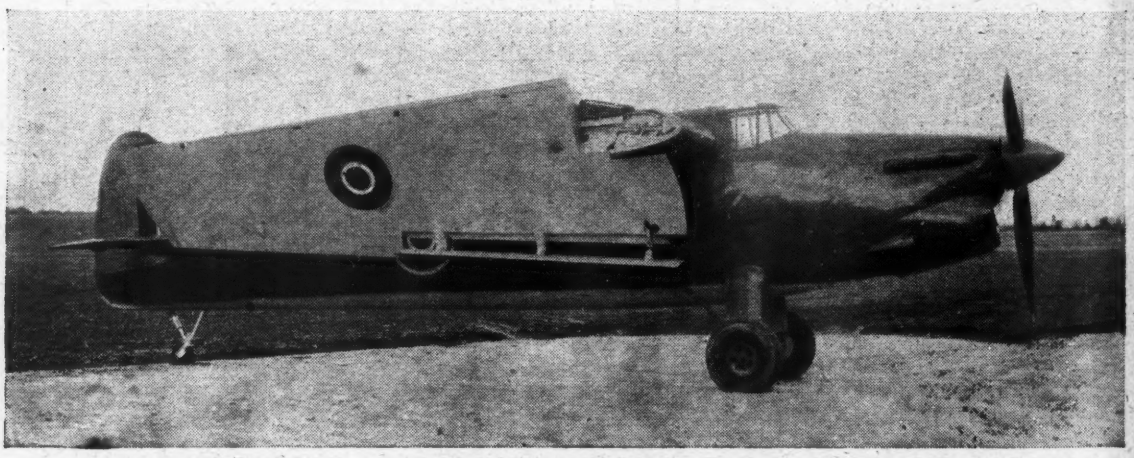
Length o.a.	40ft 0in
Wing span	50ft 0in
Height	14ft 2in
Wing area	319.5 sq ft
Ailerons	26.0 sq ft
Tailplane	29.0 sq ft
Elevators	17.0 sq ft
Fin	15.0 sq ft
Rudder	17.9 sq ft

Weights

	lb	% A.U.W.
Wing and centre section	1,750	14.6
Fuselage	1,000	8.3
Undercarriage	575	4.8
Total structure	3,600	30.0
Total powerplant, fuel supply and power services	2,825	23.5
Total load	5,575	46.5
Designed all-up weight	12,000	

Performance

Max. speed	279 knots at 4,000ft
Cruising speed	250 knots at 2,000ft



Achieving the apparently impossible. Wing folding is combined with variable-incidence wings in the 322.

Fore-and-aft control and stability provided much food for thought during the design stage. At one time it was thought that a variable-incidence tailplane would be necessary in order to prevent tail-stalling, but it turned out that the change of incidence between wing and tailplane effected by changing the wing angle caused trim in the right direction, and flight tests have proved the fixed tailplane satisfactory.

A simplification of control, from the pilot's point of view, has been effected by making the change of incidence automatically operate the slotted flaps. This is achieved by a system of swinging links, one having its fulcrum on the wing and the other on the fuselage. This arrangement was chosen so as to provide the desired relative angular movement between wing and flap. At the low-incidence end of the range, only a small flap angle is wanted. As the wing incidence increases, the flap angle becomes progressively greater. Plotted as a graph, the curve is of S-shape. In figures the two sets of angles are as follows:

Wing Angle (deg.)	Flap Angle (deg.)
2	0
4	5
8	25
12	52
14	58½
15	60

These relative angles have been found suitable both for take-off and landing.

During early flight tests of the first prototype, some interesting data were compiled. As was to be expected, they gave rather higher maximum lift coefficients than the model test in the wind tunnel. At a loaded weight of 10,000 lb (the designed all-up weight is 12,000 lb), and with engine off, a maximum lift coefficient of 2.65 was obtained with slots fully open and wing at 15 deg. incidence. This corresponded to a stalling speed of 68 m.p.h. With slats locked and wing incidence at 16 deg. the maximum lift coefficient was 2.03, and stalling speed 78 m.p.h. With engine on, slots open, and wing at 16 deg. the $C_{L\ max}$ was 3.9 and the stalling speed 57 m.p.h. At 10,000 lb weight this represented a wing loading of 31.3 lb/sq ft.

Flight tests also indicated the following elevator settings required to trim: At a mean weight of 8,900 lb, with the c.g. at 0.25 chord and the wing at 2 deg. incidence, the elevator angle was 14 deg. up at 85 m.p.h. With the wing at 15 deg. incidence and at 90 m.p.h. the elevator angle to trim was 8 deg. down.

Other data for the Supermarine 322 are shown in the graphs. There is little doubt that for certain purposes the variable-incidence arrangement is worth adopting, and the experience gained by the Supermarine works should place them in a very favourable position, should it be decided to produce other types incorporating this feature.

EIRE AGREEMENT

UNDER an air agreement signed in London on April 5th between the U.K. and Eire, Aer Lingus, Tta, is to become the sole operator for flights from Eire to the U.K. and to various points on the Continent, and Shannon is made a compulsory stop for B.O.A.C. aircraft on the trans-Atlantic route from U.K. to Canada and the United States via Shannon and Newfoundland.

The agreement takes the usual form for civil air agreements, and in the annex there are three schedules specifying various mutually agreed routes. The first schedule refers to the trans-Atlantic route already mentioned, and grants to B.O.A.C., as the designated Government air carrier, full rights of transit, non-traffic stops, and commercial entry to Eire territory on this route. Aer Rianta, Tta, is granted similar rights in U.K. territory, on a route specified in Schedule II from Eire via Newfoundland to Canada.

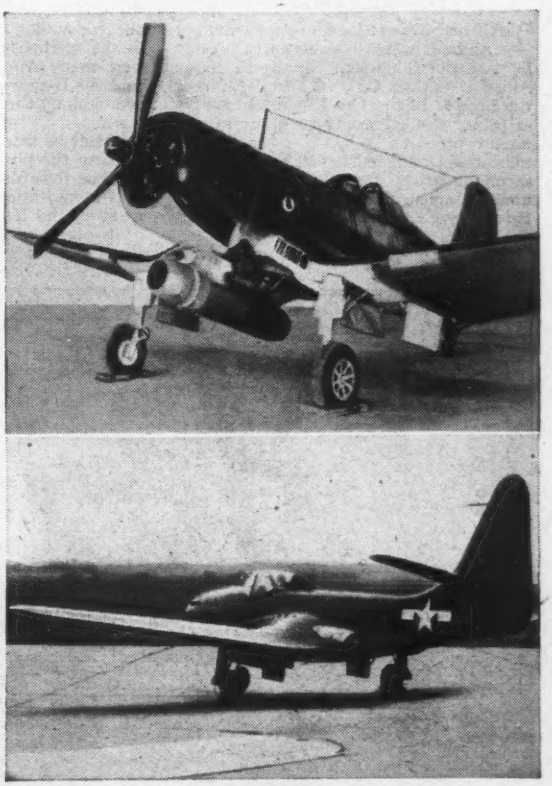
The third schedule sets out thirteen routes operating from Shannon or Dublin to points in the U.K. and, in certain instances, onwards to the Continent. In the annex, Aer Lingus, of which Aer Rianta is the holding company, is designated as the sole operator over these routes, and, in addition, is granted cabotage rights on four of the routes which operate from Shannon or Dublin through, variously, Belfast, Crewe, and Liverpool and back.

B.O.A.C. to Use Shannon

A further provision of the annex is that Shannon airport shall be used as a port of call in both directions on all trans-Atlantic flights undertaken by B.O.A.C. on that route . . . "in view of the long trans-oceanic flight necessary on the route, and considering the still limited development of aeronautical science."

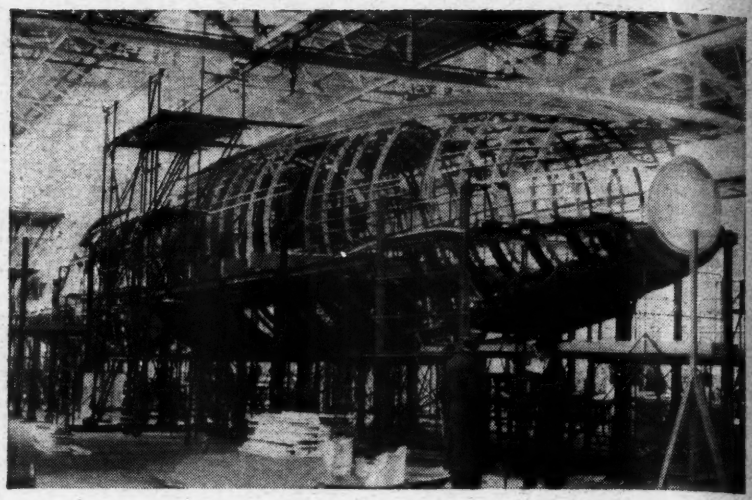
The designation of Aer Lingus as sole operator of all the services in Schedule II arises out of the Heads of a further agreement which has been initialled by Aer Rianta and B.O.A.C. This provides that air services between Eire and U.K. shall be undertaken by one company only, namely, Aer Lingus, and its nominal capital is, therefore, to be increased to £1,000,000, of which 60 per cent is to be held by Aer Rianta and 40 per cent by B.O.A.C. and/or British European Airways (the latter, when formed, is to be given an opportunity of becoming a party to the agreement). As B.O.A.C. has a fifty per cent interest in traffic operating between Eire and U.K., profits and losses arising from such traffic are to be equally shared between the parties. On the services from Eire to the Continent, profits will be divided between the parties in proportion to their shareholding in the company, but losses will be shared equally.

B.O.A.C. has stated that these new agreements do not affect their previously announced policy of routing a proportion of their trans-Atlantic services via Prestwick in accordance with traffic requirements.



EVOLUTION AND FRUITION: The upper view shows an early Westinghouse axial-flow jet unit (Model 19A) installed for test on a Chance-Vought Corsair. Below is the new McDonnell FD-1 Phantom deck-landing fighter for the U.S. Navy which has two Model 19B Yankee units in the wing roots.

HERE AND THERE



SIZE OF THINGS TO COME: Looking more like a new dirigible on the stocks than a heavier-than-air-craft, the fuselage of the Bristol 167 (Brabazon I) is taking shape in the flight shed at Filton. This is the first picture to be taken of it.

Private and Enterprising

DESCRIBED by the auctioneers as "a freehold property situate in the parish of Winthorpe, East Lincolnshire," Skegness Airfield has been bought by a Skegness resident, Mr. Gadsden, for £10,500.

The airfield covers an area of 72,820 acres and has two hangars and a row of petrol pumps.

Far East Airfield

THE new airport for Singapore, Changi Airfield, which was recently opened by Air Chief Marshal Sir Keith Park, Allied A.O.C.-in-C. of "Seac," is now the biggest in the Far East and capable of taking the biggest types of aircraft in use at present. When a 1,000 yd extension is completed it will be capable of accommodating the even larger types now in construction in the U.S. and Britain, such as the Bristol 167 "Brabazon 1."

This airfield, which is 14 miles from Singapore, was begun by the occupying Japs who set thousands of British and Australian prisoners of war to work upon it, and, with poetic justice, was completed by the labour of Japanese prisoners, who finished the laying of the 630-ton steel runway in 40 days.

It will be used by both civil and military aircraft.

Invitation Flight

A LETTER which appeared in *Flight*'s Correspondence pages recently alleged, among other things, that, owing to the methods of the U.S. Press, there were many Americans who still thought that the B-17 was the only Allied bomber ever seen by the Berliners during the past war.

If this be true (and we should hesitate to deny the possibility), then much will be done towards setting the matter right by the invitation from the U.S. Government to the R.A.F. to send a squadron of ex-operational Lancasters to take part in a New York fly-past on August 1st.

The occasion is, of course, to celebrate victory in the air, and No. 51 Squadron, Bomber Command, will fly the Atlantic to Floyd Bennett Field, near New York, and will duly "formate" with the U.S.A.A.F. on the great day. It is even expected that some of the Lancs will have crews who took part in the Battle of Berlin.

84 Group Dinner Club

SOME 400 officers of 84 Group, 2nd T.A.F., gathered at the Savoy Hotel, London, on Saturday, April 13th, when the Group's recently formed "Dinner Club" held its first function, and among the speakers was Marshal of the R.A.F. Lord Tedder, the Chief of Air Staff.

That the C.A.S. knew his T.A.F. inside out was clear from the many humourously intimate sallies he interposed in his brief review of the Group's history. In fact, the sparkle of after-dinner wit which stamped the speeches in general may be said to have set a very pleasant standard for subsequent gatherings of this dinner club to live up to.

From D-Day to VE-Day, 84 Group supported the 1st Canadian Army and was commanded first by Air Vice-Marshal L. O. Brown and then by Air Vice-Marshal E. C. Hudleston.

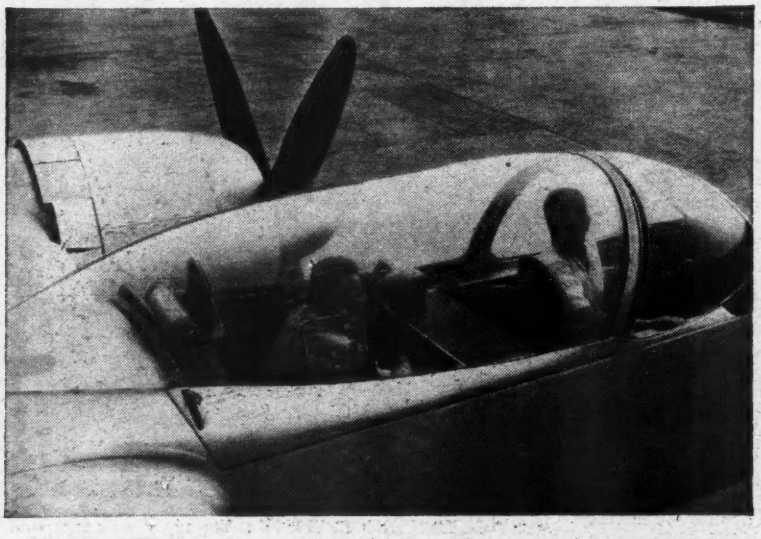
Stratovision Progress

IN *Flight*, September 6th, 1945, we published an account of the Westinghouse "stratovision" scheme to broadcast television programmes from aircraft flying at some 30,000 ft, the possibilities of which were being explored by the Westinghouse Electric Corporation in co-operation with the Glenn Martin Company. The object, briefly, is to extend the range of television, the waves of which travel in a straight line and thus virtually limit the range of a ground transmitter to the line-of-sight distance to the horizon.

Practical Tests

SINCE our article was printed, a series of practical tests have been made, and preliminary reports filed with the Federal Communications Commission in the U.S. are claimed to "verify all the optimistic estimates" of the possibilities.

The tests, checked by the F.C.C. monitoring stations, were made with a twin-engined medium bomber refitted by



DOUBLE EXPOSURE: A magnificent view is provided for the occupants of the tandem cockpits in the nose of the Northrop F-15 Reporter, which is a P.R. version of the Black Widow night-fighter. This bubble canopy is said to be the biggest piece of Plexiglass yet blown.

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At the end of a World-Wide War, towards the successful conclusion of which the M.T.Bs, M.G.Bs and Rescue Launches, originated, designed and developed by Hubert Scott-Paine and constructed by the British Power Boat Company, have played no small part, we face the stern reality of urgent work ahead. Just as high speed surface craft in the past have been conceived and pioneered by Hubert Scott-Paine for specific purposes and uses, so today intensive work is proceeding on new ideas which will maintain our position in the forefront of the World's markets . . . new boats to keep a watchful eye at sea, and others to satisfy the manifold needs of a World at peace.

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CONSTRUCTORS OF SCOTT-PAINE SURFACE CRAFT

HERE AND THERE

Glenn Martin and a ground station at the Westinghouse plant at Baltimore. Usuable signals have been transmitted over 240 air miles from 25,000 ft using only 250 watts.

Although the tests are far from complete, these initial results are hailed as bringing economically practical television and frequency-modulated radio services on a nation-wide basis at least one step nearer.

Back to the Land

LAST week we mentioned at the foot of our "News in Brief" column that Flt. Lt. Turner Hughes, Armstrong Whitworth's chief test pilot, was leaving that firm.

He duly left at Easter to set up in business for himself, servicing farm vehicles in Warwick. But he is not giving up flying, and is prepared to do any test-flying, as a free-lance, for anyone who requires his services.

Without Comment

A READER who is a member of the Bristol and Wessex Aeroplane Club has sent us a cutting from a local newspaper which solemnly reports that the club's directors "have applied to the Ministry of Civil Aviation for three 'Buster' aircraft fitted with Morris Minor engines, and pre-war members have been circularised to ascertain their views on peacetime flying."

Street Scene

WHILE flying between Cootamundra and Sydney, a Gipsy Moth purchased from the Disposals Commission had to make a forced landing, and as there was no clear country in the vicinity, used a street in a suburb of Sydney—Glamis Street, Rockdale.

Just before the aircraft completed its landing run the passenger jumped out and, hanging on to the wing tip, prevented the Moth from running into the scrub at the end of the street.

After the trouble had been cured the pilot took off, again using the street, and flew on to Mascot Airport.

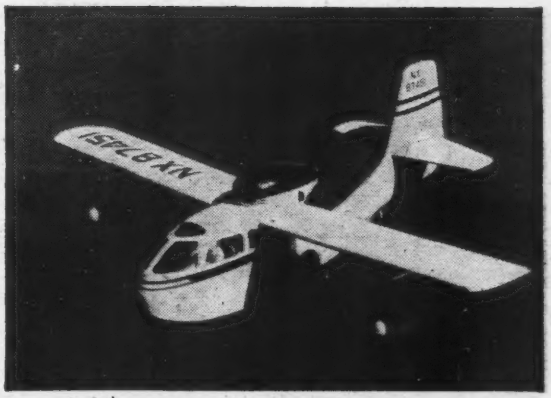
Seabee Production

THE report from Farmingdale that Republic Aviation aim at turning out their light amphibian, the Seabee, (see picture above), at the rate of 40 a day by August is a good example of the vigour with which American private enterprise is setting about the job of meeting the big demand for aircraft in the owner-pilot class.

Revolutionary simplifications in design and production methods, they say, have enabled them to market this four-seater aircraft at $3,995 (roughly £950) and at the same time easily exceed the C.A.A. static test requirements.

The production model of the Seabee is powered by a 215 h.p. air-cooled "flat-six" Franklin engine, and equipment includes two-way radio, electric starter, hydraulically operated flaps, retractable land gear, and a ground-adjustable two-bladed airscrew.

Top speed is 120 m.p.h., cruising speed 103 m.p.h., landing speed 58 m.p.h., sea-level climb 700 ft/min, service ceiling 12,000 ft, and range 550 miles Wing loading is 15.3 lb/sq ft and power loading 14.2 lb/h.p. Mass production begins next month.



This photograph of the Seabee shows the good view provided by high wing and pusher engine installation.

News in Brief

HALFAR airfield, Malta, which became famous as an air defence base during the siege of the island in 1940-41, has been transferred from the R.A.F. to the Royal Navy and commissioned H.M.S. *Falcon*.

* * *

Britain's new 16,200-ton aircraft carrier, H.M.S. *Triumph*, left the Tyne on April 15th commanded by Capt. H. N. Faulkner, to begin her trials. It is about two years since her keel was laid in the yards of Hawthorne Leslie and Co., Ltd., Hepburn-on-Tyne.

* * *

Three members of a British Mission led by Lt. Gen J. F. Evetts to investigate rocket development in Australia, arrived in the Commonwealth on April 10th. They were Wing Cdr. R. F. Harman, Mr. N. Coles, of Farnborough, and J. C. Yarrow, a Ministry of Supply expert.

* * *

A special flight is to be established by the R.A.A.F. for carrying out tests under tropical desert conditions in the heart of Australia. A Lincoln bomber and a number of jet-propelled aircraft are being sent out to the Commonwealth for use in these tests.

* * *

A "flying mailcar" version of the Fairchild C-82 Packet has been evolved to the needs of the U.S. Post Office Department for speeding up airmail service between major American cities. Special postal equipment for sorting mails in flight has been designed, and from four to six tons of mail can be handled according to the length of the flight. It is expected that Congress will approve a five cent airmail rate.

* * *

The prize of £50 offered last year by the council of the Royal Society for the invention considered to be the best advancement in the science or practice of navigation has been awarded to Mr. W. J. O'Brien for his invention, the Decca navigator.

* * *

Passengers in a railway train marooned 60 miles east of Baghdad by the Tigris floods had food supplies dropped to them by an Anson of the Communications Flight A.F.Q., Iraq Command, which made eight runs alongside the stranded train at a height of about 20ft.

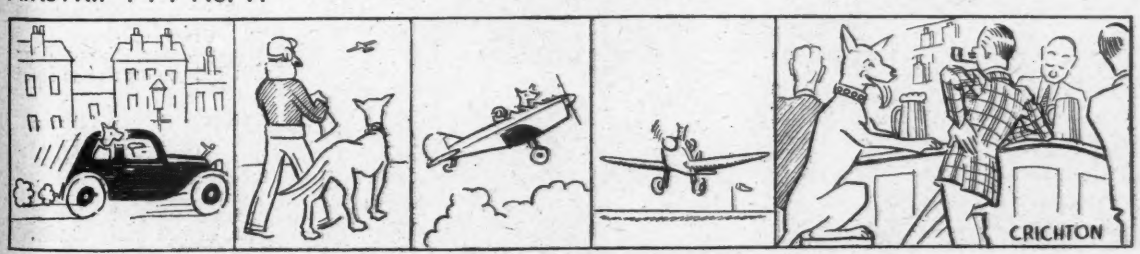
* * *

The appointment of Mr. H. T. Chapman to the board of directors of Armstrong Siddeley Motors, Ltd., has just been announced. Mr. Chapman joined the company in December, 1926, and has been general manager since April, 1945.

* * *

A new subsidiary company to Westland Aircraft, Ltd. (and entirely owned by them), called Normalair, Ltd., with offices at 8, The Sanctuary, Westminster, S.W.1, has been formed to deal with the development and production of atmosphere control equipment previously handled by the parent firm. The new board consists of Messrs. J. Fearn (chairman), E. Mensforth, W. B. Hickman (secretary) and Colonel Sorel.

AIRSTRIP . . . No. 11



Britain's Test Pilots

No. 6

PHILIP LUCAS, G.M.

PHILIP LUCAS learnt to fly on a Renault-engined Avro 504 at the de Havilland Flying School at Stag Lane in 1924. This was the pre-Moth period when surplus aircraft and engines left over from the 1914-18 war were still being used. The eight-cylinder 90 h.p. Renault air-cooled engine replaced the air-cooled rotaries previously used in the Avro 504 and gave the advantage of a throttle control instead of a plain on or off "blip" switch.

Lucas was, at the time, an engineering apprentice at Vickers, and was also one of the first twenty members of the London Aero Club. Like many young men at that time who had learnt to fly, Philip wanted more hours in the air than he could afford to buy and also the opportunity to handle some of the more powerful military types.

To this end he took a short-service commission in the Royal Air Force in 1926, serving with Fighter Command (then Air Defence of Great Britain) and the Fleet Air Arm which, at that period, was part of the R.A.F. It seems strange now to speak of "powerful military types" whereas, of course, they were only Avros (100 h.p. Monosoupape), Bristol Fighters (250 h.p. Rolls-Royce Falcon) and Sopwith Snipes (200 h.p. BR2). He was in the last course at No. 1 F.T.S., Netheravon, to be taught on rotary-engined aircraft.

Three years after joining the Service he was posted to Martlesham Heath as a test pilot. The experimental establishment, where all our most secret types are flown, is now at Boscombe Down having been moved from Martlesham when war broke out. The point about Martlesham Heath and secret machines is that a public road goes right through the centre of the camp for all to use. During the next two years Lucas remained at Martlesham test-flying multi-engined types. Nice gentlemanly aircraft they all were, with a top speed in the region of 100 m.p.h.

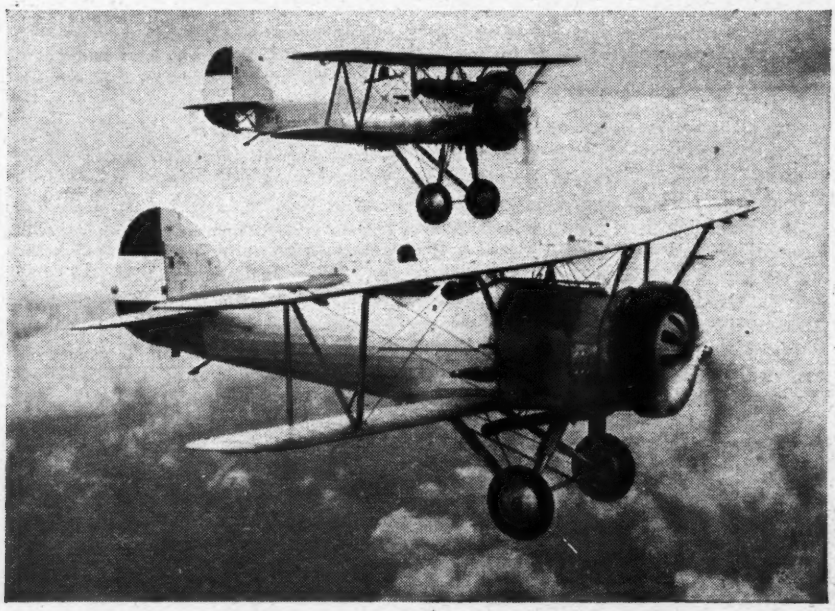
In the midsummer of 1931 he joined the Bulman-Sayer team of Hawker test pilots at Brooklands. This was in the heyday of the Hart and Fury period (with all their variants), and it fell to Philip to take many of these abroad, either for demonstration or delivery. He travelled the world over, going to Spain, Portugal, Finland, Sweden, Esthonia, Belgium, Egypt, Iraq, Persia and the Far East. He is one of the few outsiders who have lived with the Japanese Navy. In 1931 he took two Nimrods—the Fleet version of the Fury—to deliver and instruct the Japs in flying and maintenance.

Cable Aerobatics

Those who remember the R.A.F. displays at Hendon in pre-war days will recall the annual event in which a kite balloon was shot down after Major Sandbags had baled out. In 1932 the S.B.A.C. gave a show on the day following the R.A.F. display and, unbeknown to him, Lucas picked up the derelict balloon cable in the tail skid of the Jupiter Hart he was demonstrating. He went through the flying programme with this 200 yards of half-inch steel cable flailing from his tail.

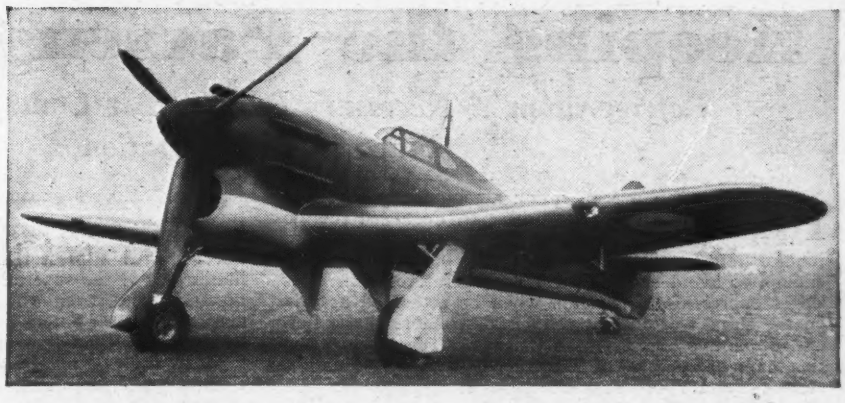
In 1933 Lucas had one of his biggest jobs. He had to go out to Ahwaz in Persia, erect a Boulton and Paul steel hangar with local labour and assemble, test-fly and deliver the Hawker Audaxes and Furies which had been bought by the Persian Government. He had three spells at this work, being relieved at intervals by Maurice Summers (now with Vickers Aviation and just recovering from a broken spine after a bale-out) and altogether over 100 aircraft were delivered.

When Jerry Sayer was appointed to Glosters as chief



A Hawker Fury and Audax of the Persian contract in 1933, being test flown from Brooklands airfield before despatch. The Fury and Audax both had 700 h.p. Pratt and Whitney Hornet engines.

test pilot, it meant that Lucas did a fair amount of development work on the Hurricane. It was on one of the early Hurricanes that he nearly "bought it." While doing a climb to rated altitude (17,000 ft) fog obscured the ground, and feeling his way down carefully to get his bearings, he took most of the fabric off the underside of his wings on some trees in the Kenley area. All the later Hawker types—Hotspur Henley, Tornado, Typhoon, Tempest and their variants—were his responsibility. It was on the Tornado that he felt the effects of compressibility, and it appears that this was the first time it had been recognised, and possibly the first occasion on which it had been experienced.



The Hawker Tornado with Rolls-Royce Vulture engine on which Lucas first experienced compressibility effects.

Whilst flying the prototype Typhoon he had an experience which probably was tied up with compressibility trouble, and it showed the calibre of pilot he was. He could hear the fuselage breaking just aft of the cockpit but, remembering how much time would be lost in building another prototype, he did not bale out, but remained with the aircraft and managed to land it in one piece. How the need for secrecy in wartime can cover a great deed! Philip was awarded the George Medal and the prosaic citation read:—"Lucas displayed great courage and presence of mind during a test flight and by his skill and coolness saved an aircraft from destruction."

Lucas has now handed the reins over to Humble, but he still does an appreciable amount of flying in addition to his duties as a director and general manager of Hawkers. To date he has flown some 120 types and has 3,450 flying hours in his log books. His hobbies are golf and gardening.

No. 7. WILLIAM HUMBLE, M.B.E.

Chief Test Pilot, HAWKER AIRCRAFT CO. LTD.

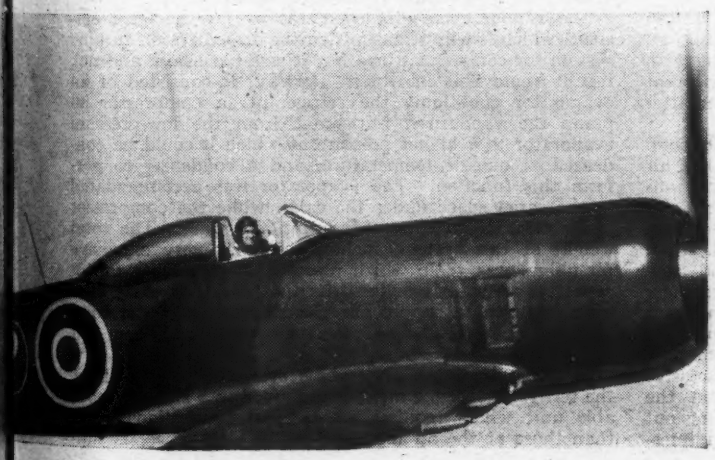
BILL HUMBLE is one of the modern school, having learned to fly at Marshall's Flying School in Cambridge in 1929. Trained as a professional mining engineer, and employed in the coal industry, Humble's pre-war flying was done entirely for fun, and an exuberant love of flying is still one of his ruling passions.

In addition to his pre-war appearance at social gatherings and air-race meetings in his Speed Six Hawk, he was on the Reserve of Air Force Officers, and was one of the original members of No. 504 Special Reserve Squadron. When war broke out he was called up and spent 10 weeks at No. 11 F.T.S. at Shawbury as an instructor. By this time governmental regulations caught up with him and he was hauled back to the mines.

It took just 11 months for Bill to persuade the authorities that he was more use in a cockpit than in a coal pit, and eventually he was instructed to proceed to Sealand for flying duties. He was actually on his way there with Willie Wilson (the world's speed record holder) when he called in at Hawkers and never got any farther. It was arranged between the R.A.F. and M.A.P. that he should join the Hawker Company as a test pilot.

At first he helped with production testing of Hurricanes and Typhoons only, and then lent a hand with prototype development under Ken Seth Smith who was unfortunately killed in August, 1942. He has since taken a very active part in the development of the Tempest and Fury and the first flights of any new aircraft which emanate from the Hawker drawing boards will now be his responsibility.

With the less urgent days of peace now with us, the test-flying of prototypes and production aircraft is tending to merge, and all will be under his department. Humble has 3,300 flying hours to his credit and has flown 66 different types. Three times he has entered for the King's Cup Race but never got nearer the leader than 5th. J. Y.



Bill Humble shows his appreciation of the flying qualities of the Tempest II in the usual manner.

Keeping the Passenger Cool

Refrigeration a Necessary Part of Air Conditioning : Its Place in Pressurization

IT is a common misconception among many engineers, according to Bernard L. Messinger, Lockheed thermodynamic expert, that aircraft air conditioning does not require refrigeration simply because one can fly high enough to avoid excessive cabin temperatures. Mr. Messinger expressed this opinion when he presented a paper on the subject of aircraft refrigeration before the Society of Automotive Engineers at Chicago. The "misconception" might be more or less true, he agreed, for unpressurized aircraft, but it was not at all the case for pressurized transports, as could be easily demonstrated.

On a normal summer day the airliner would have to reach a height of at least 7,000ft before the temperature of the air surrounding it dropped to the comfortable figure of 75 deg F (this premise can hardly apply to the U.K.), and even then the cabin could not be maintained at this temperature without the removal of heat, owing to the numerous internal sources of heat, such as the occupants, solar radiation through the windows, and various electrical devices. A further rise in temperature was also caused by "stopping" the air which is brought into the aircraft, and in the boundary layer, which envelops its whole external surface; kinetic energy is transformed into heat energy and, at modern rates of climb, may be as much as 5 or 6 deg F, and up to 15 or 20 deg F in level flight.

For these reasons a cabin without refrigeration would run a temperature of 85 to 95 deg F at 7,000ft on a summer day, and a still higher figure would result at lower altitudes. Even adequate ventilation providing one complete air change per minute, it has been found, will not keep the temperature inside the cabin down to within 10 deg F of the outside temperature.

It is no answer to say that the airliner with a pressurized cabin operates at altitudes very much greater than 7,000ft. It must be remembered that passengers necessarily spend quite an appreciable length of time in its cabin while the aircraft is on the ground—a length of time which varies according to type and circumstances. For example, the average time for taxying and engine run-up is about ten minutes in the case of a twin-engined transport, and for

On a normal summer day the airliner would have to reach a height of 7,000 ft. before the temperature dropped to a comfortable figure.

a four-engined type would probably be nearer fifteen minutes. Then there is the time taken to obtain clearance from the control tower; on a large airport operating with a heavy flow of traffic this delay has, on occasion, kept aircraft on the ground for as long as half an hour after the moment when the passengers took their seats.

The present-day airline passenger expects complete comfort from the moment he climbs aboard, and because air travel is being sold to him as an altogether superior means of travel he will immediately compare the degree of comfort provided with the standards to which he has grown accustomed in luxury trains and first-class sea travel. First impressions are acknowledged to be important, and from the standpoint of the psychological effect on the passenger —especially a new airline customer—the conditions which prevail at the beginning and end of a flight are of primary importance. If he is subjected to discomfort from high temperature, high humidity, poor ventilation, excessive noise and vibration during his first few minutes in the aircraft, and in the last few minutes before stepping out of it, then it is quite likely that these unfavourable impressions will colour his reaction to the whole trip and to air travel in general.

These arguments apply with even more force to the aircraft with a pressurized cabin, because the practical limitations of the superchargers cuts down the ventilation flow-rate, and, even when inter-coolers of high efficiency are used, the air enters the cabin at a temperature appreciably higher than that of the outside air.

When the Constellation was designed in 1939 refrigeration equipment was included as part of its air-conditioning system, but when war turned the aircraft into a military transport refrigeration was one of the amenities which disappeared. Then in 1945, when the design was again being revised to conform to its original purpose, it was

Entrained air and boundary layer kinetic energy is converted into heat and may be up to 15 or 20 deg F in level flight.

decided to try to make the Constellation the most comfortable aircraft available to operators. This entailed incorporating all the original air-conditioning features and several new ones into an entirely new system which should be complete and also flexible enough to meet every conceivable requirement of the airline operator. The most interesting part of this system—because it tackled an entirely new problem—is the refrigeration equipment. [For high-altitude operation, humidification is even more important.—ED.]

Three different types of refrigeration plant were explored before settling on that now used. The original equipment was the Freon vapour compression type such as is used in nearly all commercial applications, but after considerable research and development the air expansion turbine system was decided upon as the most practical for application to the Constellation. Oddly enough this system is almost extinct to-day in the commercial field and it is significant that the peculiarities of an aircraft are such that a system of refrigeration which has been superseded in every other field of application should prove to be the most practical of all. A third and very simple system, in which the air from the cabin would be circulated over slabs of the frozen material, was examined for its possibilities, but proved to have a number of serious drawbacks, not the least of which was the liberation of a prohibitive volume of CO_2 during pressurized operation.

The vapour cycle first tried was by far the most efficient (which is why it has ousted the air expansion turbine system for commercial use) but it was too heavy and not readily removable in winter. Briefly, it consisted of an evaporator containing the refrigerant, a compressor to pump the vapourized refrigerant from the low-pressure evaporator to a higher pressure at which it could be condensed at outside temperature, and a condenser to perform this function. The evaporator was accommodated in the cargo space under the cabin while the compressor and condenser were housed within the wing. The total weight of this system, including its not very extensive plumbing, was 585lb which represented 58.5lb per ton of capacity. A special engine-driven alternator of 20-25 kilowatt capacity to supply the electric motors of the compressor and condenser fan absorbed between 40 and 50 h.p.

In the case of the air turbine system adopted, all of the refrigeration equipment is contained in a single removable unit which requires no external connections other than those at the air inlet and outlet. No power is sup-

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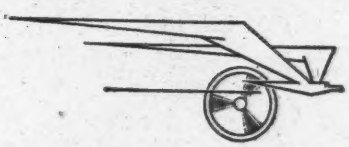
PRIOR to the war these companies were engaged in operating and managing flying schools and clubs. During the war they completed the overhauling and reconditioning of over 1,200 aircraft for the ROYAL AIR FORCE, comprising HURRICANES, BLENHEIMS, MUSTANGS and BEAUFIGHTERS. In addition, they operated a flying training school at which over 6,000 ROYAL AIR FORCE pilots were trained.

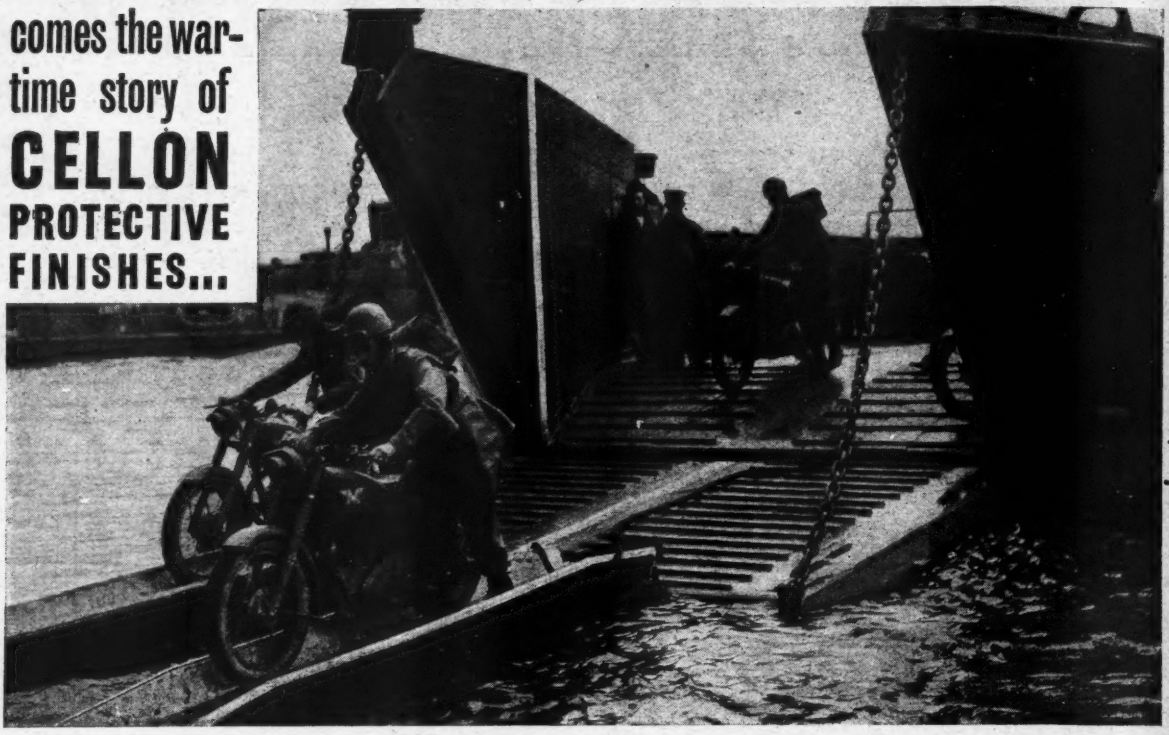
The services of these two companies are now at the disposal of all who are interested in civil flying, whether club members, or private owners of aircraft.

WINGS ARE THE WHEELS OF TO-MORROW

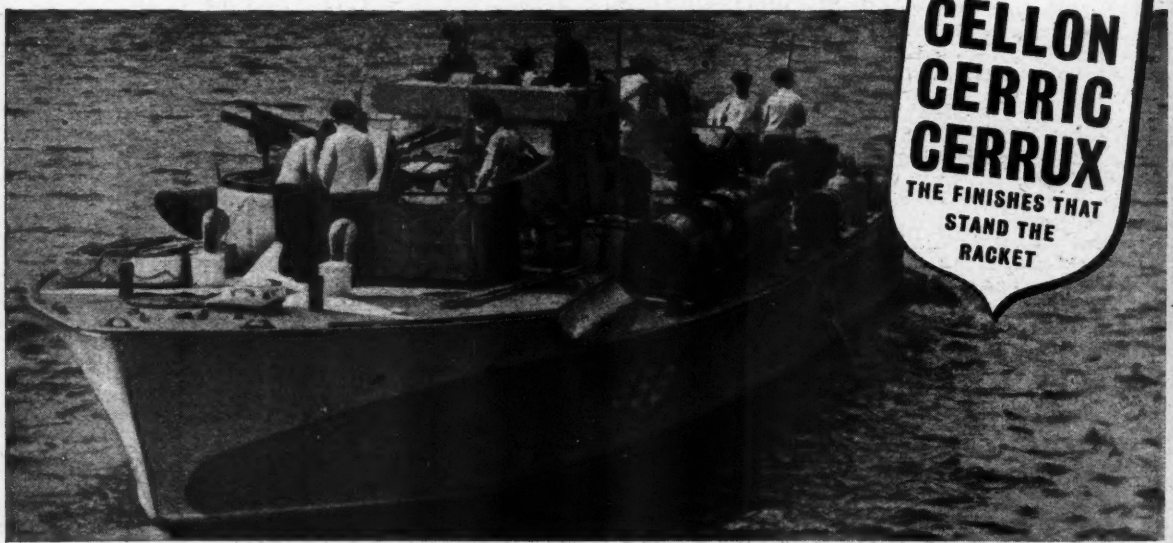


OUT OF THE (SEA) HORSE'S MOUTH

comes the war-time story of CELLON PROTECTIVE FINISHES...



Continuously assaulted by sea-water, or crashing down the bomb-torn roads of Europe, the vessels and vehicles of war needed as tough a hide as science could devise or industry produce. Exposed to arctic cold and tropical heat, Cellon Protective Finishes have been used for those duties in which the efficiency of the device was dependent upon the durability of the 'finish'. 'Dukws,' Launches, Landing Craft, Tanks, Trucks, Invasion Barges, Airborne Life-boats, Mine-sweepers, and a host o. other essential warships, vehicles and their gear, absorbed most of our wartime output. With the end of hostilities the high quality ingredients of Cellon Protective Finishes are again becoming available for commercial purposes — better than ever as a result of six years concentrated experience and research.



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KEEPING THE PASSENGER COOL

plied to the unit by mechanical or electrical means, this is taken from the cabin superchargers, which are no larger than if designed for pressurization alone. This is because the full capacity of the superchargers is only required for cabin pressurization in the thin air at high altitudes, and thus there is ample to spare for refrigeration in the denser atmosphere at lower altitudes.

The air enters through two flush scoops on the underside of the leading edge of each wing and is delivered to the primary centrifugal compressors in the outboard nacelles. From both compressors the air is ducted, via a single primary intercooler, to the adjacent refrigeration unit in the starboard wing, and thence, via a water separator, to the cabin. The inter-cooler fan is driven through a right-angle reduction gear from the turbine-compressor shaft of the refrigerator unit; coolant air is drawn from a flush opening in the lower surface of the wing and discharged through an opening in the trailing edge.

The complete unit is "shock-mounted" at the four lower corners and is quickly detachable through the lower surface of the wing when not required during winter operation, a section of duct then being provided to take its place.

Incidentally, the primary centrifugal compressors in the outboard nacelles are driven from the engines through variable speed transmissions which permit full refrigeration capacity to be obtained at engine speeds down to 1,200 r.p.m. But the problem of cooling on the ground when the engines are not running is simplified by the fact that a supply of compressed air, at about 15 lb/sq in, such as could be supplied from a truck-mounted compressor, is all that is required.

The only point on which this system suffers by comparison with the original vapour compression cycle is that it absorbs a maximum of 120 h.p. as against some 50 h.p., and is therefore less efficient in terms of energy consumed per unit of refrigerating effect. Against this, however, it scores heavily by weighing only 250lb compared with 583lb, in being compact and quickly detachable, and in occupying no valuable cargo space. Other advantages are that, because the air itself is the refrigerant, small leakages can be tolerated whereas in the Freon or alcohol systems any leakage is serious; except for the coolant fan and its driving gear, the unit can be considered a "one-moving-part" mechanism; and finally, the cycle is so simple that no highly specialized training is required for the engineers who will service it.

DESIGNER RESIGNS

MAJOR J. D. RENNIE, for more than twenty years chief seaplane designer to Blackburn Aircraft, has resigned from that post. It is to be hoped that this fact does not indicate that Blackburns are leaving the seaplane field, especially now when the Government is showing an active interest in flying-boat development. Among the seaplanes designed by Major Rennie those best remembered will be the Iris flying-boat family, the Perth, and such highly original craft as the B.20 with retractable planing bottom described last week.

"TREKKING" UP-TO-DATE

WITH the arrival in the Colony of an Auster J.1, Sierra Leone has its first privately owned civil machine. It is owned by Mr. John Birch, prominent executive of the United Africa Company in Sierra Leone, who will now be able to combine business with pleasure when he makes his "aerial trek" from Freetown into the Protectorate to visit the company's outlying branches at Bo, Magburaka, Port Lokko and Daru.

"This is what Africa wants," said Mr. Birch. "I think that light planes such as the Auster could be of great use here."

PATHFINDER FORCE—NEW SECRETARY

THE Pathfinder Association, Limited, which, for the time being has its premises at 115, Mount Street, Berkeley Square, W.1, has a new ex-Master Bomber Secretary, Flight-Lieutenant J. A. Thorne, D.S.O., D.F.C. Squadron-Leader Brant, the retiring secretary, who has done a great deal for the Association since its foundation, retains his seat on the council.

Nearly 3,000 Pathfinders have enrolled as members and good work is being done in helping ex-Pathfinder Force personnel to get suitable jobs.

R.A.F. FLYING CLUB UNDER WAY

A SMALL party of old members and friends met at Panshanger Airdrome, near Hertford, on Saturday, April 13th, to see the first post-war flight of the Royal Air Force Flying Club. In the bright sunshine after lunch, Wing Cdr. R. F. G. Brittain (the founder and joint chairman), accompanied by Sqn. Ldr. K. W. Hole, took off in one of the club's Moth Minors. For the time being the R.A.F. Club, London Aeroplane Club, and the E.F.T.S. Tigers will share Panshanger.

After making a first R.A.F. Club post-war circuit of Panshanger field near Hertford, Wing Commander R. F. G. Brittain and Squadron Leader K. W. Hole hand over the controls of the Moth Minor to Wing Commander Brown and Flight Lieutenant Macbeth.

Although the facilities are rather limited, all essentials are provided—parachute room, office, restaurant, bar—and, as Wing Cdr. C. A. Pike (C.O. of the D.H.-run E.F.T.S. and hon. sec. of the R.A.F. Club) remarked, the austerity brings back some of the old pioneer spirit of the early days of flying clubs.

As soon as possible the club hopes to increase its fleet of two Minors and a Hornet Moth (which is on the way) by the addition of one or more Austers and, perhaps, by the use of a Tiger Moth.

Although it is designated the R.A.F. Club, all three Services are entitled to become flying members provided that they have completed the stipulated minimum of 200 hours' flying as pilot.

It will be remembered that the R.A.F. Club organized two very successful displays back in 1934 and 1935, and it is hoped that they will be able to do something of the kind again. The present committee have big plans for the next year or two. The inaugural meeting of the club was in April, 1933, and Lord Trenchard was the first president. His Majesty The King has been Patron of the club since 1937.

METRO-VICK

A.116.

British Axial-flow Unit with Efficient Ducted-fan Thrust Augmentation : High Thrust, Low Specific Consumption

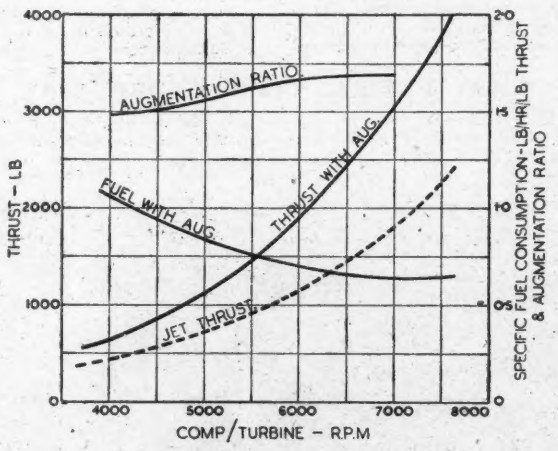
GAS TURBINE

WHEN it is appreciated that Metropolitan-Vickers, Ltd., have a virtually unsurpassed background of steam turbine experience and, further, this is allied to what is, perhaps, the foremost mechanical sciences research organization existing in the commercial world, then it will not occasion surprise that such a company should take its place in the front rank of gas-turbine progress as applied to aircraft propulsion. The axial-flow type gas turbine is so basically at an advantage in the critical factor of thrust/unit frontal area that on this score alone its development is imperative. Another advantage is the low specific fuel consumption.

The unit which forms the subject of this survey is a straightforward axial-flow compressor and gas turbine with which has been incorporated a ducted-fan thrust augmenter. By this means the thrust delivered by the unit has been increased by 67 per cent., for an unchanged fuel consumption and for an increase in weight of only 33.3 per cent. In specific terms, the plain jet part of the unit produces a static thrust of 2,400 lb for a weight of 1,650 lb, so giving a thrust/weight ratio of 1.455 : 1, but the unit when fitted with the augmenter gives a static thrust of 4,000 lb for a weight of 2,200 lb, *i.e.*, a thrust/weight ratio of 1.818 : 1 which shows a percentage specific gain of 25. It must also not be forgotten that this achievement is paralleled, if not eclipsed, by the reduction in specific fuel consumption. The great thing about the embodiment of the thrust augmenter is that the gain in thrust is realized without any increase in fuel consumed. This results in the specific consumption coming down to 0.65 lb/hr/lb thrust, which is some 35 per cent lower than that hitherto regarded as best obtainable, *viz.*, 1 lb/hr/lb thrust.

The static thrust rating of 4,000 lb is, of course, for sea level conditions, and that proportion of the overall thrust contributed by the augmenter will decrease with increase in flight speed—very much in the same way that conventional airscrews lose tractive efficiency with increase in aircraft speed. Further, the fall-off in augmented thrust occurs with increased altitude, again in accordance with those same laws which cause an airscrew similarly to lose efficiency. However, the thrust drop of the augmenter is not parallel with that of an airscrew and can, in point of fact, be largely modified by the incorporation of a variable-area outlet orifice.

Perhaps the best way of visualizing a ducted-fan thrust augmenter in general terms is to regard it as something of a half-way measure between pure jet propulsion and airscrew propulsion. It has been shown that smaller losses are occasioned by moving a large mass of air rearward fairly slowly—as in airscrew propulsion—than is the case when a small mass of air is moved rearward at high velocity—as in pure jet propulsion. By including ducted fans in conjunction with jet propulsion, the thrust obtained from the jet alone is somewhat reduced, but a tremendous gain in overall thrust is provided by the fans entraining a relatively large mass of air and driving it rearward fairly slowly relative to the jet velocity.



These curves show graphically the respective thrust values of the pure jet and augmented units, together with fall in specific consumption. The low end of the curves is *not* the idling condition, this being at approx. 2,500 r.p.m.

The streams from the gas turbines and the fans are separated and do not mingle until both have left the jet pipe. Thus at the orifice there is, in effect, a hot high-speed jet from the turbines, and a cold lower-speed annular jet from the fans, the latter stream cylindrically enclosing the jet stream. This has an effect on noise suppression which is most marked, and the unit is, without doubt, the quietest aircraft propulsion engine of any kind ever developed. There should be a very useful future before it on this count alone for passenger aircraft, aside from the inherent lack of vibration and extremely good performance.

Flow through the unit is uncomplicated and simple to

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The Silver York ready for the first trip to Johannesburg.

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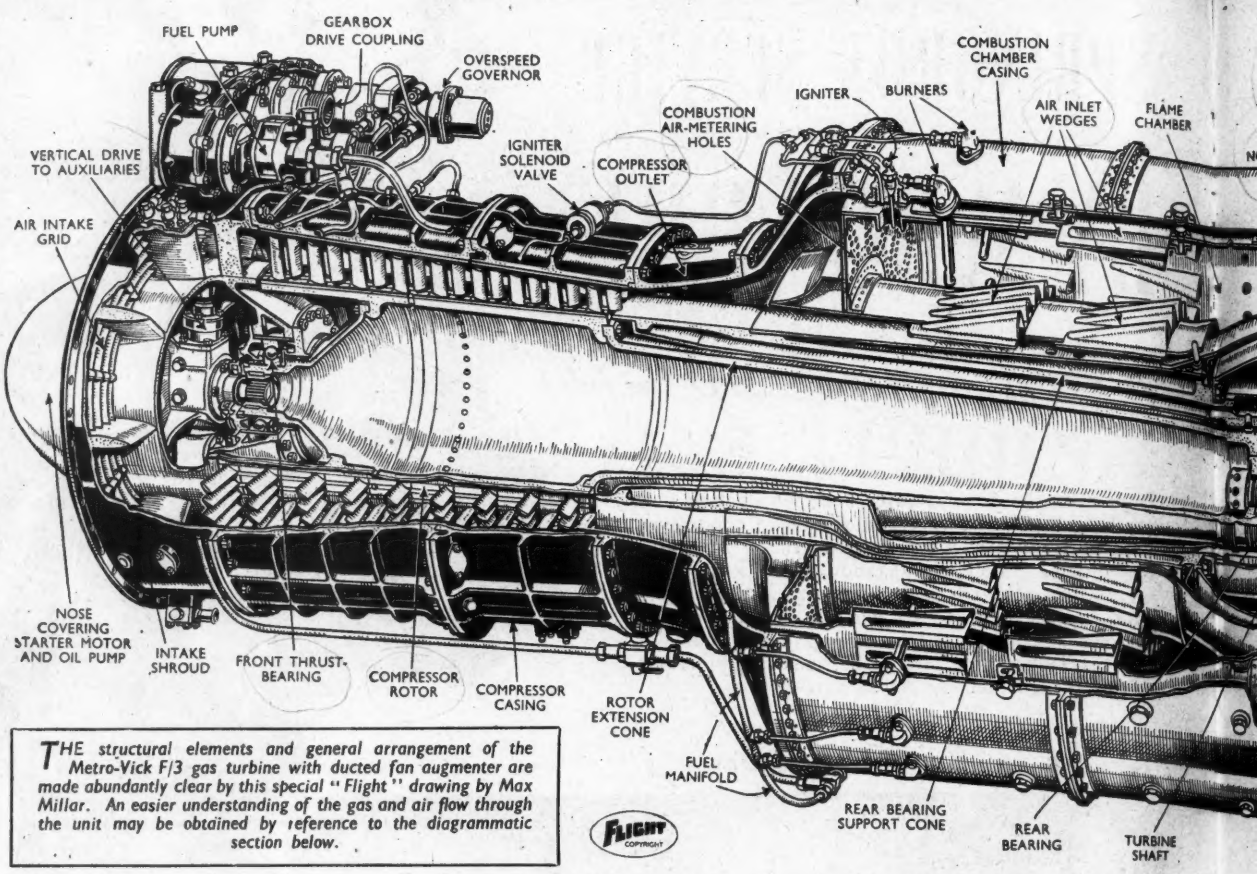
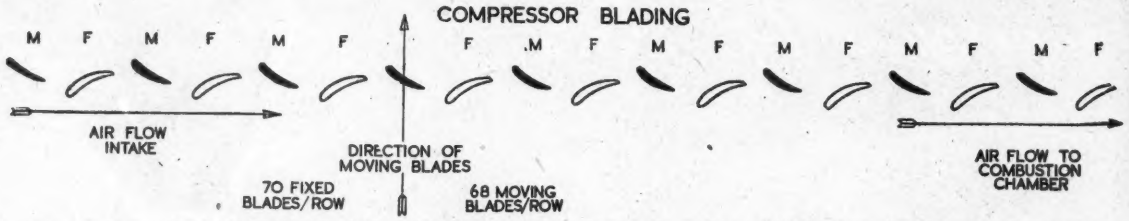
METRO-VICK F/3 GAS TURB



THE structural elements and general arrangement of the Metro-Vick F/3 gas turbine with ducted fan augmenter are made abundantly clear by this special "Flight" drawing by Max Millar. An easier understanding of the gas and air flow through the unit may be obtained by reference to the diagrammatic section below.

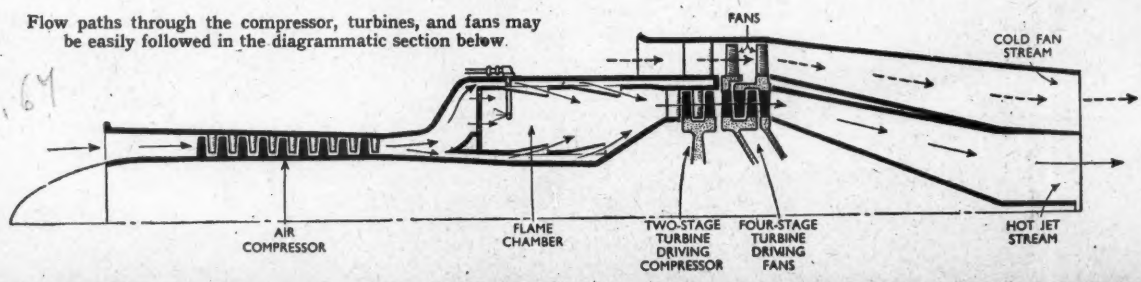

COMPRESSOR BLADING
M F M F M F F M F M F M F M F M F
AIR FLOW INTAKE
DIRECTION OF MOVING BLADES
AIR FLOW TO COMBUSTION CHAMBER
70 FIXED BLADES/ROW
68 MOVING BLADES/ROW

Above and on the right the blade relationship, direction of rotation, and numbers of blades in each stage are set out as an aid in following the flow through the unit.

understand, the air entering the intake to the compressor through a concentrically ringed guard which might be termed an "anti-Daunt" screen. There are 70 fixed and 68 moving blades on respectively each stator and rotor stage of the compressor, all the fixed blades being similar in detail design, as are all the rotor blades; that is to say, all blades of one type are identical in twist, chord, camber, t/c ratio, etc., but the fact that they are cropped progressively in stages gives the moving blades, in effect, a coarser pitch in the higher stages than in the earlier stages. Compression ratio is 4 : 1 and, since the final ring, or stage, of blades is a stator, the flow from compressor to combustion chamber is truly axial and has no helical component.

On entry to the annular combustion chamber, the air is divided by a deflector ring into two annular streams, each of which flows around the flame chamber. The latter is

Flow paths through the compressor, turbines, and fans may be easily followed in the diagrammatic section below.



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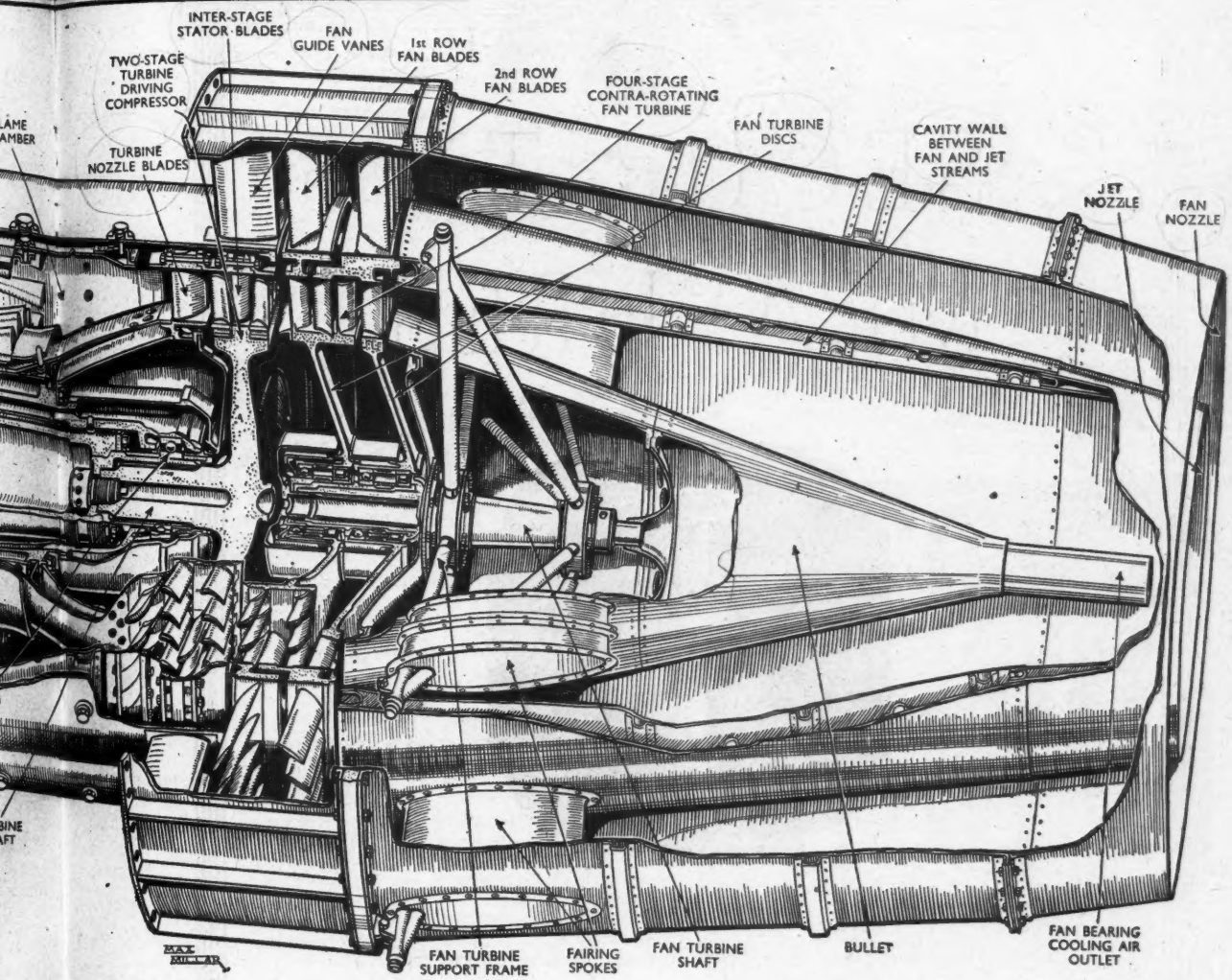
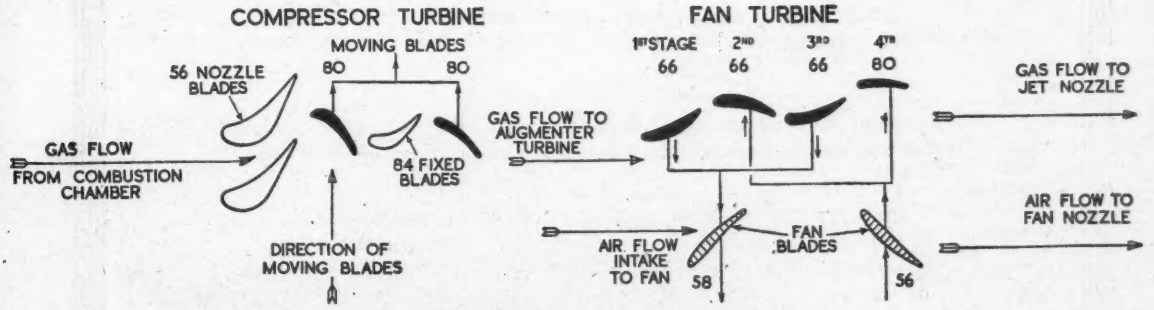
URBINE.....



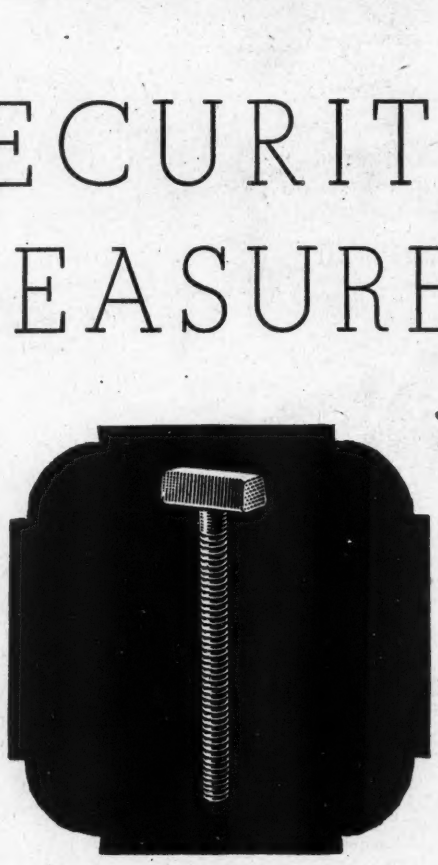


also annular in shape and is housed concentrically within the combustion chamber. The inner and outer walls of the flame chamber are pierced by 80 wedge-shaped inlets staggered in two rows of 20 each, and the surrounding air stream is admitted to the flame chamber through these wedges downstream of the burners. In the forward end-plate of the flame chamber is a multiplicity of small holes through which a governed flow of "primary" air from the compressor delivery is metered to the burners, the amount of air abstracted being merely sufficient to support combustion.

The burners are plain shrouded tubes spaced at 18 degree intervals and projecting radially inwards into the flame chamber with forward facing—that is, upstream—nozzles. These produce a dense-cored cone of fuel at 650 lb/sq in which, meeting the primary airflow in the opposite direction, brings about a high degree of turbulence and facilitates instant and complete combustion. This combusted gas is then tremendously swelled by the relatively large mass flow of cool "secondary" air admitted to the flame chamber through the wedges, resulting in an immediate and very large expansion, with a consequent high-velocity flow to the turbine.

The first ring of 56 blades are fixed and so arranged as

SECURITY MEASURES



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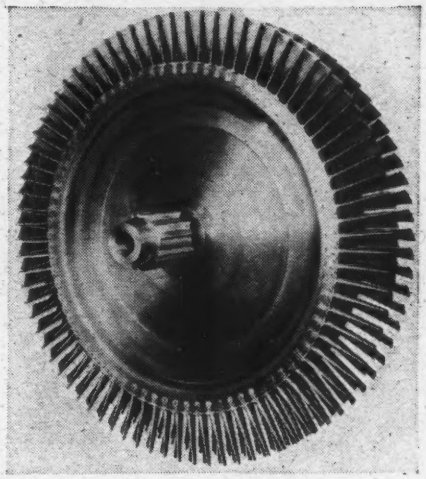
METRO-VICK GAS TURBINE



Front view of two-stage compressor turbine wheel. Note the unusual "M" form splines on the drive shaft; presumably this is a measure for reduction in stress concentration.

to form a nozzle ring to the moving turbine blades. These last are mounted in two rows of 80 each on the turbine disc and are separated by a ring of 84 stator blades interposed between them. This, then, comprises the *first* turbine, the sole purpose of which is to drive the compressor, and the maximum speed of which is 7,600 r.p.m.

Immediately rearward (downstream) of the first turbine is a second turbine, composed of two contra-rotating wheels, which operate in the gas stream exhausted from the first turbine. This second turbine is for driving the fans, also arranged in two banks which counter-rotate, and, as the two rings of turbine blades on each wheel or disc are nested together, with one row of each interposed between the two rows of its neighbour, the unit can justifiably be regarded as a four-stage component. Additionally, since the nested blades counter-rotate, the necessity for fixed rings of stator blades is eliminated. The rotational speeds of the fan turbine wheels are much lower than that of the compressor-turbine, the first fan wheel rotating at 2,850 r.p.m. and the second wheel at 2,300 r.p.m.; both these speeds correspond to maximum static thrust.

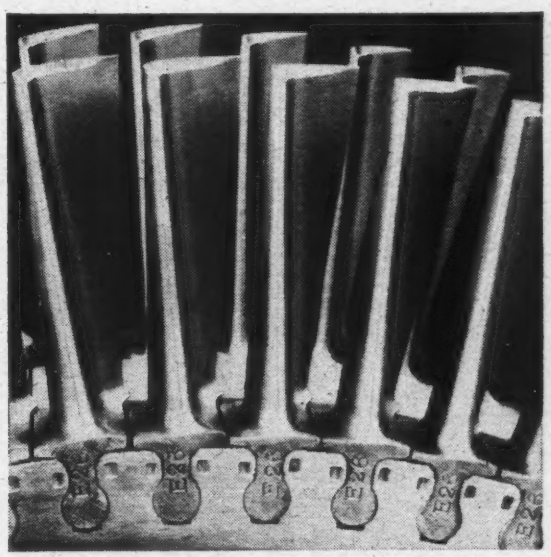
Fan Blade Mounting

Having passed through the four blade stages of the second turbine, the gas efflux flows down the roughly constant-velocity tail pipe to the outlet orifice. The ideal sectional profile for the tail pipe would, of course, be progressively curved in conformity with the expansion of the gases for a uniform velocity of flow, but as this raises difficulties in production, the tail pipe cone profile is made as a fixed-angle cone and, for all practical purposes, the flow characteristics can be regarded as conforming to constant-velocity laws.

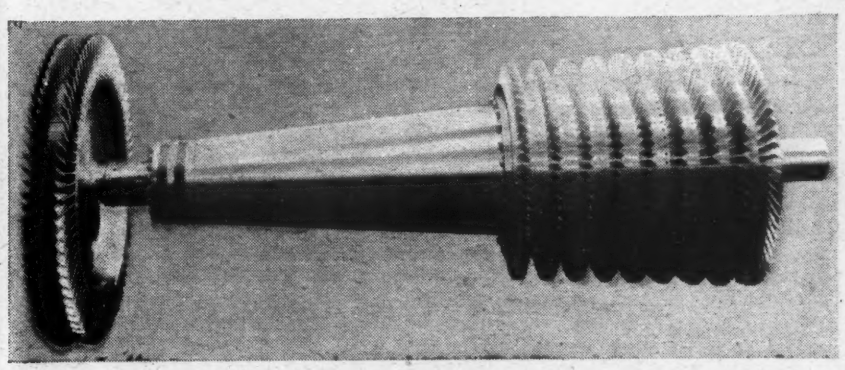
The ducted fans are arranged in an extremely ingenious manner, and the structural aspect of the blade mountings is so brilliant as to take on the semblance of technical courage. This is not actually the case since so much research has gone into the design as to provide very sure foundations, yet at first sight the method adopted is such as to strike one as far fetched.

As may be seen from Max Millar's drawing, the fan blades are mounted on rings carried on the blade crowns of the second turbine. The "torque" loads on the turbine and fan blades compensate one another, and, since the turbine blades are designed to "windmill" and the fan blades to "screw," this is not particularly difficult; but the centrifugal loads and bending loads cannot be cancelled-out and these must have occasioned the designer no small trouble. The matter is further complicated by the fact that labyrinth seals have to be introduced between fan and turbine blades to preclude untoward pressure losses as between the turbine stream and fan stream; and when it is realised that the temperature difference between these streams is of the order of 600 deg C, the ingenuity and quality of the design may be appreciated.

The intake for the fans is an annulus surrounding the gas turbine/compressor part of the unit,



Detail of turbine blading showing "bulb" anchorage and peen locking. The provision of rubbing strips on the blade crowns is taken from steam turbine practice.



Turbine and compressor rotor assembly showing the cone extension member which transmits the turbine drive to the compressor.

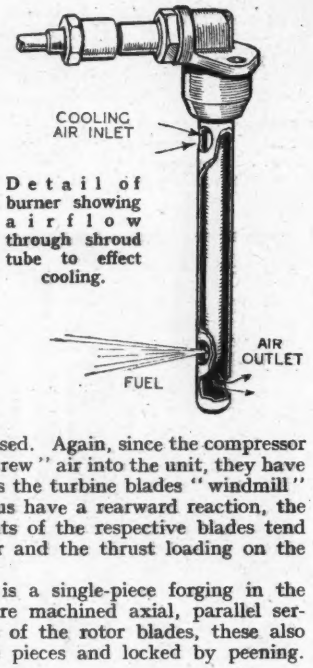
and the overall diameter is approximately 48 inches; from the fans the augmenter air stream is thrust rearward in an annular tapered throat isolated from, yet surrounding, the jet gas stream, until it reaches the outlet orifice in the same transverse plane as the jet orifice. There is thus no confluence of the two streams until they have left the unit.

On the subject of thrust augmentation, as previously stated this will fall off with increase in flight speed, since the limitation imposed on the fan stream velocity by the

METRO-VICK GAS TURBINE

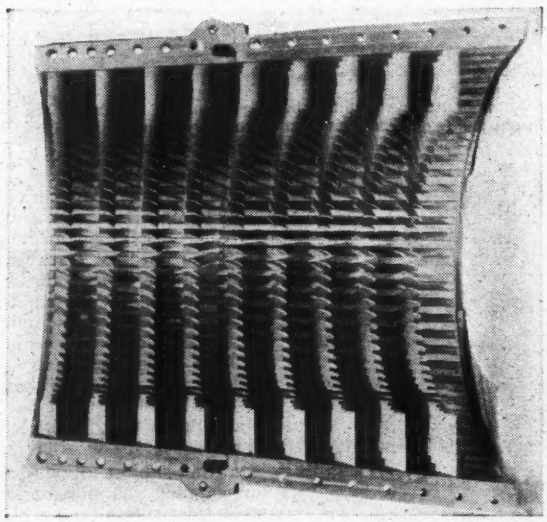
area of the outlet orifice progressively reduces the thrust efficiency of the fan stream. If, by having a variable outlet, the area of the orifice can be reduced proportionally to the rise in flight speed, for a given mass flow the stream velocity will be increased and thus the efficiency of propulsion may be extended to higher speeds, with a consequent delay in thrust drop from the augmenter.

Structurally, the build-up of the main elements can well be seen in the cut-away drawing, but we may with advantage briefly survey the salient points of the structural composition. The casing of the compressor is an RR50 light-alloy casting in four parts, top and bottom, front and rear, the former bolted together at horizontal meeting faces, and the latter bolted together circumferentially in the transverse plane of the sixth rotor stage. Dovetail-section axial slots are machined in the bore of the casing, and the stator blades are held in these, spaced by distance pieces and locked by peening. Bolted to the front face of the compressor casing is the intake shroud which, by means of "spokes" across the intake annulus, supports a coned diaphragm in which the front thrust bearing is housed. Again, since the compressor blades are designed to "screw" air into the unit, they have a forward reaction, and as the turbine blades "windmill" in the gas stream and thus have a rearward reaction, the opposed thrust components of the respective blades tend to compensate each other and the thrust loading on the bearing is so reduced.



Detail of burner showing airflow through shroud tube to effect cooling.

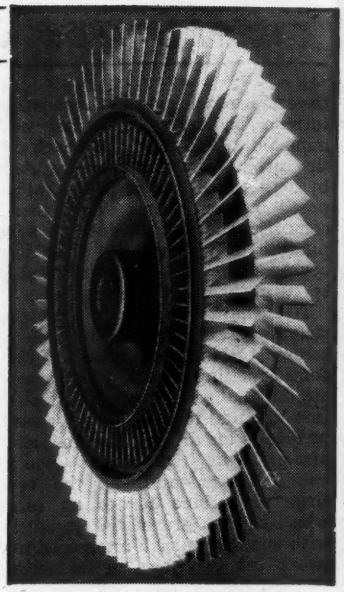
The compressor drum is a single-piece forging in the outer surface of which are machined axial, parallel serrated slots for anchorage of the rotor blades, these also being spaced by distance pieces and locked by peening.



Compressor half casing showing stator blade stages and joint between front and rear sections.

A coned diaphragm, bolted internally to the drum at the third stage station, is spigoted to run in the front thrust bearing, and internal splines in the bore of the spigot transmit the drive through a splined quill shaft for powering the auxiliaries. The starter motor is housed within the "spinner" and engages the forward end of the quill shaft through a plain dogged coupling.

At the rear end of the compressor drum is bolted a conic extension, this having bolted to its rear end an internally-splined sleeve which runs in the rear journal bearing and houses the splined shaft of the overhung turbine wheel. The journal bearing just mentioned is housed within the rear end of another cone extension member (this one being co-axial with, and enclosing, the internal extension cone) which, at its forward end, is bolted to the rear face of the compressor casing and is vented at this point to form the compressor outlet branch.



Augmenter fan assembly showing relation of contra-rotating fans and their turbine. The build-up of fans and turbine can be seen in the cut-away drawing.

Lubrication and Cooling

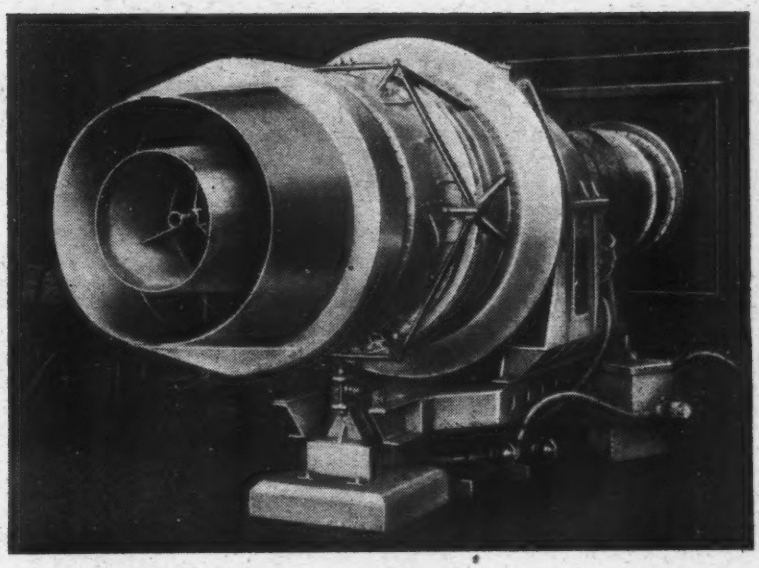
Surrounding these two co-axial cone extension members is the annular combustion chamber, the form of which has already been described. Suffice to say it is fabricated in commercial quality, high-temperature sheet steel developed by Firth-Vickers before the war and known as Immaculate 5. Jointing faces are formed by machined flanges spot-welded to the main fabric, units being attached by through-bolting adjacent flanged faces.

At the rear end of the combustion chamber, the stator blade stages for the turbine are anchored in peripheral rings bolted together, and the inner ends of the first row of blades (the nozzle ring) are supported on a cone diaphragm bolted at its forward end to the outer extension member, which houses the turbine bearing.

Each of the twin discs of the fan turbine is separately supported on a pair of roller and ball-thrust bearings, both sets of bearings running on a common shaft, which is carried in a six-point, triangulated star-bracing of tubular members which also serve to support the fan ducting and jet tail cone or bullet. A glance at the cut-away drawing will serve to make clear the arrangement. The method whereby the fan blades are carried off the crown of the turbine blades has already been described.

Before passing on to the starting and running control systems it may well be advantageous to review the extremely clever cooling and lubrication methods. Going back to the compressor end of the unit, radial holes through the compressor drum, or rotor, at the fourth stage supply air under 4th-stage pressure to the interior of the drum, whence it flows along inside the cone extension and is admitted to the turbine bearing and, in so doing, energises a "scent spray" in order to provide an air/oil mist to lubricate the bearing. The mist is then evacuated back along the cavity between the inner and outer cone exten-

METRO-VICK GAS TURBINE

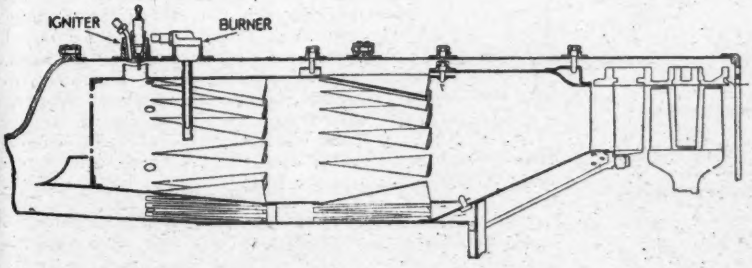


Rear view of unit with augmenter showing outlet orifices and tubular bracing members. The flange forward of these is a bell-mouth intake to the fans for test bed purposes only.

sions and is gathered in a circumferential duct externally surrounding the compressor outlet, whence it is vented to atmosphere. External pipes also supply air to a similar scent-spray nozzle at the front bearing for cooling and lubrication—principally the latter—and the drain is by a short pipe carried inside the bottom spoke of the intake shroud and vented to atmosphere.

Cooling air is supplied to the front face of the turbine disc through a channel arranged between the inner and outer cone extension, the air supply being abstracted from the final compressor stage. At the wheel face a deflector plate ensures that the air is impinged on the disc near the centre, and it flows radially outward to escape into the jet stream past the roots of the turbine blades, which it also cools. The crowns of the turbine blades, and the roots and crowns of the stator blades, are cooled by tappings from the secondary air supply in the combustion chamber. It is also worthy of note that air from the same source is supplied to the burner shroud tubes in order to cool the burners, escaping through vent holes at the rear of the shrouds into the flame chamber.

Vent points at the sixth compressor stage supply air under pressure for piping to the apices of the "star" frame supporting the fan turbines, the air being conducted down inside the tubular members of the frame to the interior of the hollow turbine shaft. Part of this air supply is diverted to the bearings where a feed of oil in one of the bracing frame tubes makes an oil/air mist for lubrication; the rest of the air is devoted to cooling both the rear face of the compressor-turbine disc and the front face of the foremost fan-turbine disc. The mist from the fan-turbine bearings is allowed to escape into the interior of the bullet tail-cone, and is exhausted into the jet at the outlet orifice. It must surely be agreed that these measures of cooling and lubrication show a degree of design quality more than deserving of parity with other aspects of this highly interesting unit.



A section through the combustion chamber illustrating rows of air inlet "wedges" and outlet throat to turbine. The flame chamber is supported by peg locations projecting internally from the combustion chamber, and is thus fixed radially although free to move axially for thermal expansion and contraction.

The fuel and control system is really very simple. Fuel is supplied from the aircraft tanks to a low-pressure filter, whence it flows to the suction side of the engine-driven fuel pump, being delivered from there to the throttle valve, with a tapping taken from the main line to feed a barostat. From the throttle valve the fuel is piped to a centrifugal governor and thence to the main high-pressure cock control, after which it is supplied to a manifold feeding the twenty burners. The barostat is simply an aneroid device for regulating the fuel supply according to the atmospheric conditions obtaining; in short, it compensates for drop in density with altitude. The governor is incorporated as a safety measure to limit the speed to maximum r.p.m. by cutting down the fuel supply and thus prevent overspeeding.

A tapping from the fuel pump delivery line taken off just before the throttle valve supplies a solenoid valve and, subsequently, two igniters at roughly 11 o'clock and 1 o'clock on, or in, the combustion chamber.

To start the unit, the pilot switches on and the starter motor, solenoid valve and igniter sparking plugs are energised. The opening of the solenoid valve permits fuel to flow to the igniters, and the spark initiates a local plume of flame. At the same time the starter motor is accelerating the turbine and compressor and, as soon as a rise in fuel pressure is registered on the gauge, the high-pressure fuel cock is opened and fuel is at once supplied to all 20 burners. The flame plumes at the igniters immediately promote combustion throughout the chamber and thus the unit starts and picks up speed; when the load on the starter motor is relieved, a throw-out switch breaks the starting circuit.

Normal flight operation is by a single throttle lever actuating the throttle valve—it is the only engine control the pilot has to concern him.

There can be little doubt that, Metro-Vick having pointed the way, ducted-fan thrust augmenters have come to stay, and although the overall diameter of the unit is thus increased, the gain in thrust obtainable by this means, and the amazing drop in specific fuel consumption, render the enlarged nacelle a very worth-while payment.

In any case, working on a specific basis of pounds of thrust per square foot of cross-sectional area, the pure jet part of the unit has a ratio of 321.5 lb/sq ft when used alone, whilst when incorporated with the augmenter, although the diameter has increased, the jump in thrust gives a ratio of 318 lb/sq ft. On this basis, then, which is regarded as a criterion, the greater size of the augmented unit is shown to occasion a negligible difference.

CIVIL AVIATION

London Airport

Summary of the Plans for Heathrow : Proposed Layout : Development North of Bath Road

AS a result of a question asked by his predecessor, Viscount Swinton, regarding the development of the London Airport at Heathrow, the Minister for Civil Aviation made a statement in the House of Lords on April 10, in which he summed up the current position with regard to the airport's immediate and long-term futures. He also referred Members to a plan showing the boundaries of the airfield, and the proposed layout, including the extensions to the north of the Bath Road.

The following is a report, practically verbatim, of the statement:—

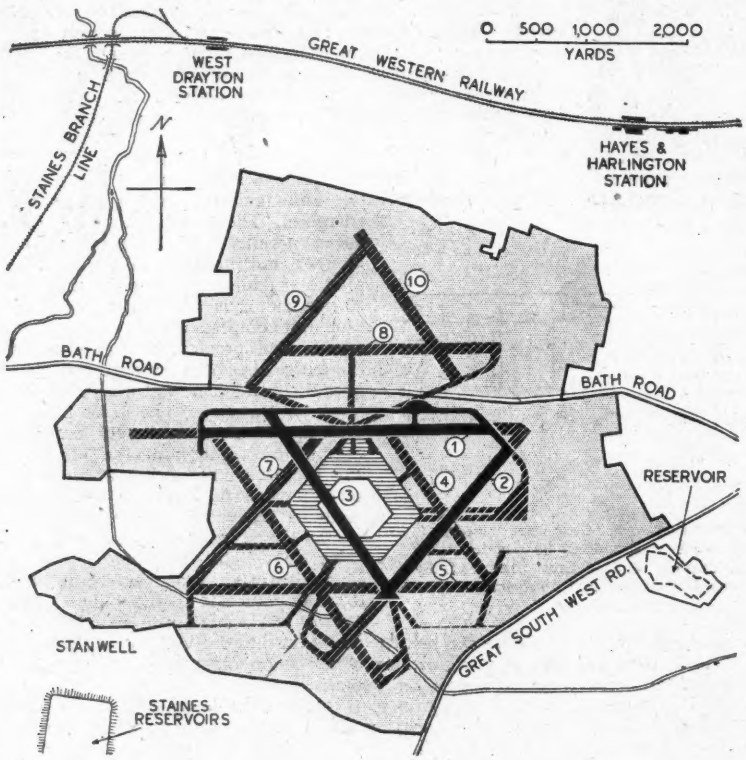
The site is only about twelve miles from the centre of London, and being on the west side of the capital, it is comparatively free from industrial haze and has a favourable meteorological record. It has good road access, and this will be better still when certain plans which the Minister of Transport has under consideration have been carried out. The land is remarkably level, both on the site and in the surrounding area, and the gravel subsoil has excellent bearing and drainage qualities. To meet the need for a major air terminal to serve London, fifty-two sites were surveyed, and no better site for the purpose could be found than the one at Heathrow.

One of the main runways, 9,000ft long, is now completed and is in use. Two subsidiary runways 6,000ft long are in an advanced state of construction and will be ready in July. Until permanent buildings are erected, passenger-handling facilities will be provided in temporary hutted accommodation between the main runway and the Bath Road.

As regards further development, the total area of land which, subject to Parliamentary approval, will be acquired is something over 4,000 acres. It extends both north and south of the Bath Road. The ultimate airfield layout will consist of three sets of parallel runways—nine in all—with the terminal area in a central position. The runways will vary in length between 9,200 and 5,300ft, but one can be extended, if necessary, to 15,000ft and another to 12,000ft. Three runways will be capable of use at a time, and the maximum capacity of the airport when entirely completed (in accordance with the accompanying diagram), will be 160 aircraft movements an hour in good weather and 120 aircraft movements an hour in bad weather. One take-off or one landing each counts as an aircraft movement.

Many different runway designs, including the much-debated tangential pattern, have been considered. In order to have the best possible advice, consideration of the runway layout was referred to a committee on which outside experts as well as Ministry staff served.

Although nine runways are to be available when the airport is fully developed, the plan actually shows ten. The explanation is that one of the runways—marked No. 3 on the plan—will, in due course, cease to be used as such, but all except a small portion of it will be used for other purposes. If this runway had been retained as such in the final plan, a greatly inferior layout would have resulted, and the terminal area, which must be centrally situated, would have been badly cramped.

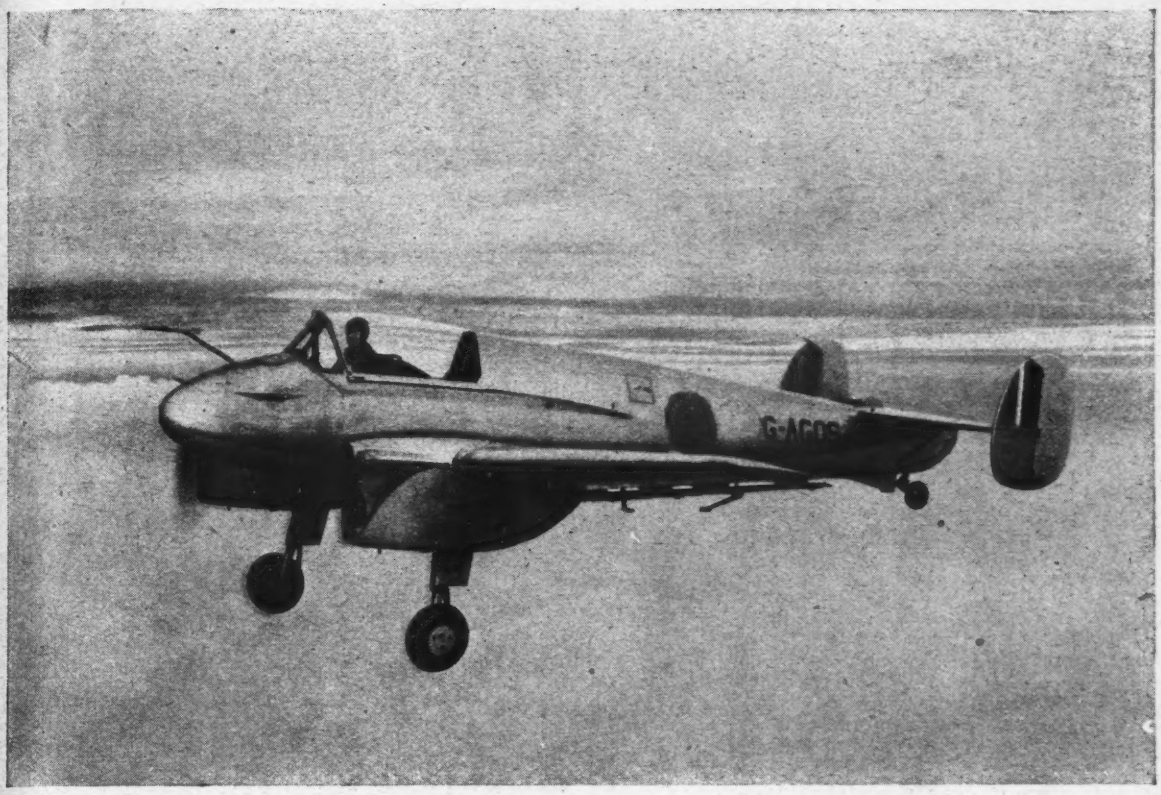


This diagram gives a very good idea of the ultimate extent of Heathrow airport. All the runways numbered 1 to 7 are south of the Bath Road and are included in the immediate scheme of development. Work on the three runways 8, 9 and 10, north of the Bath Road, will not begin for at least five years, and no demolition of houses in that area is contemplated before that time. The Bath Road will be diverted in due course. No. 3 runway will go out of use ultimately, as such, in order to make way for the terminal building.

The Buildings

The terminal building is intended to be worthy of London's main airport, and all necessary steps will be taken to ensure this result. In addition to bays for aircraft loading, traffic handling accommodation, rooms for aircraft employees and for operator's staff, there will also be all the amenities which a passenger would expect to find at a first-class airport.

The total area of land required is extensive, but not when considered in relation to the capacity of the airport. The main reasons for so large a tract of land are the need for long runways for safe operation in all weather conditions by large modern aircraft, the wide separation between runways essential for safety reasons, particularly in bad visibility, the large terminal area required for passenger handling and related activities, and the generous space which must be



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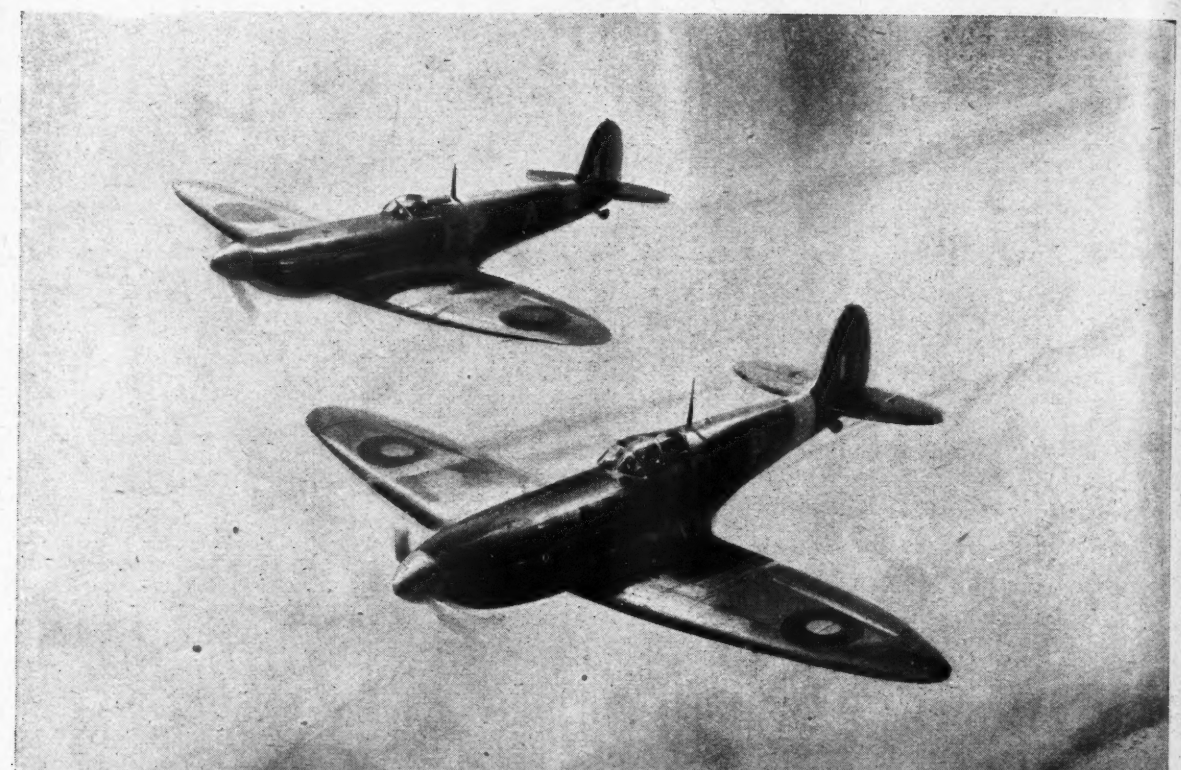

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LONDON AIRPORT

allowed for hangarage. The area south of the Bath Road will be fully developed as rapidly as circumstances allow, so as to provide six runways in all. Development of the area north of the present Bath Road, which will have to be diverted to the north of the new boundary, will not start for at least five years.

This phasing of the work will fit in with the need to minimise demolitions while the present housing shortage continues, and to keep the maximum amount of agricultural land in cultivation for the next few years. The Government is aware of the anxiety which has been felt, and expressed, by residents in the area, and will endeavour to mitigate hardship, and in the event of a continuance of housing shortage in this area in five years' time, the Government will arrange with the local authorities concerned to provide houses in place of any which have to be demolished. One of the reasons which led to the siting of the London Airport in this district was that it could be done with the minimum disturbance of householders. Compensation will, of course, be payable for houses and other buildings demolished, on the basis prescribed in the relevant Statutes. Steps will also be taken to mitigate the loss of agricultural land, and to make as good use as possible of available land during the conduct of the operations.

The area contains some buildings of archæological or historic interest, and the plans for the development of the airport have been so framed that there will be the minimum disturbance of such buildings.

The airport at Heston has become completely out of date and, owing to its proximity to the new London Airport, will have to go out of use as an airfield. The land thus made available will do much to compensate for the loss of the building and agricultural land which will be absorbed by the new airport. The buildings at Heston will prove of great value to the British airline operators for various non-flying purposes, such as the accommodation of stores and motor transport.

Following the Minister's statement, further questions were asked by Lord Strabolgi and Viscount Swinton, as a result of which Lord Winster emphasized that both he and the Minister of Transport were fully alive to the necessity for developing access to the airport in parallel with the work of completing the airport itself. The question of road access was at present under the greatest detailed consideration, while rail transport was being examined in conjunction with the main railways and the London Passenger Transport Board. Finality on the matter could not be reached, the Minister declared, until there was a decision on the ultimate location of a terminal building in London for our airlines. For airport employees access would probably be provided by extending the Underground railway beyond Hounslow West to the airport itself.

The Minister added that Commonwealth and trans-atlantic services would be able to use Heathrow this summer, as soon as the first three runways were completed.

When Viscount Swinton was speaking he stated that he had no doubt that Heathrow was the one and only possible site for a great London airport. It had been considered by the R.A.F. really as a civil aviation problem long before the Ministry of Civil Aviation had been created. Viscount Swinton said that when he went into office he considered it his duty to go into the matter afresh with an entirely open mind and to view all possible sites. He continued: "Not only did it appear to me quite conclusively that Heathrow was the best site, but I say it without the least hesitation that it was the only possible site on which a great airport for London could be built."

CIVIL AVIATION NEWS

HELICOPTER RESEARCH

RESEARCH and experimental work on helicopters is being carried out on behalf of the Ministry of Supply by three aircraft firms. Each firm is producing designs which, it is hoped, will lead to the production of small helicopters of the four-seater class for both civil and military use. This information was given by the Minister of Supply in the House of Commons in a written answer recently. The reply added that helicopter research was also in progress at the Royal Aircraft Establishment and at the Airborne Forces Experimental Establishment.

SKY "BLUE TRAIN"

IT is now possible to fly from London to the Riviera in one day. Air France has reopened its through service, and passengers leaving Croydon at 9 a.m. reach Nice by 3 p.m. the same afternoon, a call being made at Le Bourget *en route*.

As the California Airport at Nice has been extended and is now able to take large aircraft, the pre-war practice of operating a shuttle service of small aircraft between Marseilles and Cannes in order to connect with the main service from London, which was routed via Paris and Lyons to Marseilles, is no longer necessary. Thus, the new service is an all-round improvement over the pre-war line to the Riviera. The single fare for the journey is £14 10s, and at present the return fare is double this figure, but as from July 1 it will be reduced to £26 2s.

Air France hopes shortly to inaugurate a direct *non-stop* service from London to Nice—a flight of about 3½hr.

PILOTS' STRIKE

THE strike habit has spread to civil aviation. The Air Line Pilots Association of the United States has informed the National Mediation Board that it intends to call a strike of all pilots and co-pilots of Trans-World Air Lines, beginning on April 21st. This arises out of a demand for more pay and shorter flying-time when operating the new four-engined aircraft which the company is introducing, first on its international, and then on its internal routes. Pilots' salaries up to a maximum of $16,000 (£4,000 a year), and a ten per cent reduction in the maximum monthly flying-time, are the figures quoted.

So far, other airlines are not affected, but nevertheless, it is estimated that if the strike materializes it will ground all T.W.A. aircraft on more than 28,000 miles of international and domestic routes. As airlines come under the Railway Labour Act, President Truman may intervene to avert the strike by appointing an emergency panel to hear the case.

SCOTTISH QUESTIONS

THE subject of Prestwick is now becoming a regular feature of Wednesday question time in the House of Commons. On April 10, the subject received slightly new treatment when Sir Thomas Moore asked the Parliamentary Secretary to the Ministry of Civil Aviation how many times since VE-Day it had been necessary to divert to Prestwick incoming aircraft owing to fog-bound conditions at other airfields.

One imagines that Sir Thomas Moore primarily had civil operations in mind, and that he therefore received something of a surprise when he was told that from VE-day to March 31, 1946, only five civil aircraft arriving in the U.K. from abroad were so diverted. Three of these diversions were made in accordance with the "weather minima" laid down by the United States Civil Aeronautics Administration in connection with the use of Hurn by Pan American Airways and American Overseas Airlines. On the days that the American aircraft were diverted, however, Hurn continued to be used by B.O.A.C.

In contrast to the figure for civil aircraft, Mr. Ivor Thomas quoted, for the same period, 162 military aircraft either diverted to, or recalled to Prestwick. During the period October 1, 1945, to March 31, 1946, twenty-four civil and sixty-four military aircraft were diverted to or recalled to Prestwick on account of bad *landing* conditions elsewhere.

Flt. Lt. Beswick asked whether the facts which Mr. Thomas had given did not simply indicate that Hurn required up-to-date radio landing aids, to which the Parliamentary Secretary replied that it might be so, but that the policy was to get the London Airport into operation as quickly as possible so that the use of Hurn as a trans-oceanic airport could be discontinued.

In reply to a question on the organization of civil aviation

CIVIL AVIATION NEWS

in Scotland, Mr. Thomas said that in accordance with the policy embodied in the Civil Aviation Bill, it was not intended to make use of the existing operating companies in Scotland, but that staffs of those companies which were operating on November 1 *last*—the date on which the Government's policy on civil aviation was announced—would be offered employment with the new corporation on conditions of service not less favourable than those under which they had hitherto been employed.

B.O.A.C. MAGAZINE

THE first number of a B.O.A.C. House magazine called "Speedbird" was published early this month. It is excellently produced and illustrated and contains not only news of primary interest to members of the Corporation but also many items of general civilian aviation interest. The magazine should prove a great asset to B.O.A.C. and do much to keep its employees up to date with air transport events.

AVIATION BILL CHALLENGED

AN Opposition amendment to the Government's Civil Aviation Bill has been tabled by Mr. Churchill, Mr. Eden, Mr. Harold MacMillan, Mr. Lennox-Boyd, Sir Wavell Wakefield and Air Comdre. Harvey. The Bill will be debated shortly after the Easter Recess, and it is clear that it will be fought through all its stages by the Conservative Party.

In the following terms, the amendment asks for the House of Commons to reject the Bill:—

> This House declines to give a second reading to the Bill which arrests the development of the new industry of civil aviation by confining all passenger and freight services, present or future, to Government monopoly corporations; refuses the partnership of experienced aviation and transport undertakings; vests all real control of operations and finance in the Minister; involves the taxpayer in heavy subsidies; affords no security to independent charter operators; denies to the travelling public any effective appeal against inadequate services or excessive charges.

U.S. AGREEMENT CONTRETEMPS

IT seems that the conclusion of civil aviation agreements with the United States may not now be quite so satisfactory as was at first thought. The U.S. Senate Commerce Committee declared last week, by a convincing majority, that all the agreements so far completed were "illegal and void." This arose out of the introduction by Senator Owen Brewster, Republican Representative of Maine, of a resolution declaring that "*no agreements of this character should be made except in the form of treaties to be considered for action and ratified by the Senate.*" The resolution, which received a majority vote of 17 to 1, recalled that the State Department's arguments in favour of regulating international commercial air transport by bilateral executive agreements had been challenged by major American transportation interests, who argued that agreements were "prejudicial to the United States, and especially to the interests they represented."

It is understood that before action can be taken on the resolution it will need to go before a full meeting of the Senate, which would have to pass a Bill if it wished to nullify the agreements already completed. The State Department, in its turn, claims that it was fully within its constitutional rights in negotiating executive agreements without submitting them as treaties for a majority approval by the Senate.

The outcome of this domestic fracas is awaited with great interest as, amongst others, the treaty concluded at Bermuda with the U.K. is affected.

THE CHRISLEA ACE

SUBJECT to the success of the tests on the Monaco engine which will be used, the prototype Chrislea Ace should be ready for its first test flight in the near future. This tricycle-undercarriaged, high-wing cabin four-seater is being laid out in "two-control" form—a wheel and column operating all three surfaces. Mr. R. F. Stedman, who previously flew for Blackburns, has recently joined the company as chief test pilot.

MINISTRY APPOINTMENTS

THE expected regrading of the Ministry of Civil Aviation and its staff has now taken place. With effect from April 1, it has become a "first-class Department of State" and the following senior appointments have been made: Permanent Secretary, Sir Henry Self; Deputy Secretary, Mr. W. C. G. Cribbett; Chief Aeronautical Advisor, Air Chief Marshal Sir Frederick W. Bowhill; Director-General of Technical Services, Air Vice-Marshal A. C. Collier; Under Secretary, Mr. A. H. Wilson.

The posts of Director-General and Deputy Director-General of Civil Aviation have now been abolished. Two additional Under Secretaries will be appointed in due course.

Sir Henry Self has been with the Ministry since the beginning of the year; Mr. Cribbett, who becomes his Deputy, was formerly Deputy Director-General of the Civil Aviation Department before it became a Ministry; A.C.M. Sir Frederick Bowhill was formerly A.O.C.-in-C. Transport Command, and is at present the U.K. member on the Interim Council of P.I.C.A.O., an appointment which he will continue to hold until he assumes his duties at the Ministry on July 1; A.V.-M. Collier was Deputy A.O.C.-in-C. Transport Command from 1943 until the beginning of this year, when he took over the command of No. 3 Group, Bomber Command.

BREVITIES

Owing to the acute shortage of accommodation at Shannon, American Overseas Air Lines are seeking permission to moor a houseboat on the river near the airport in order to house crews and over-night passengers.

* * *

The construction of a vast new airport for Hongkong at Pingshan has been abandoned by the British Government, and the land is to be restored to agricultural use.

* * *

In a paragraph headed "South American Express" in the issue of *Flight* for April 11, the cost of airmail to South America is quoted as 1s 6d per ounce. This should read 1s 6d per half ounce.

TERMINAL TRANSPORT: B.O.A.C. and R.A.F. Transport Command have jointly ordered 375 of these 20-seater Commer "Commando" coaches for service between airports and town centres in many parts of the world. The observation-type "Park Royal" body facilitates ample luggage accommodation, and the temperature of the very comfortable interior is thermostatically controlled.

INITIALS *worth remembering*

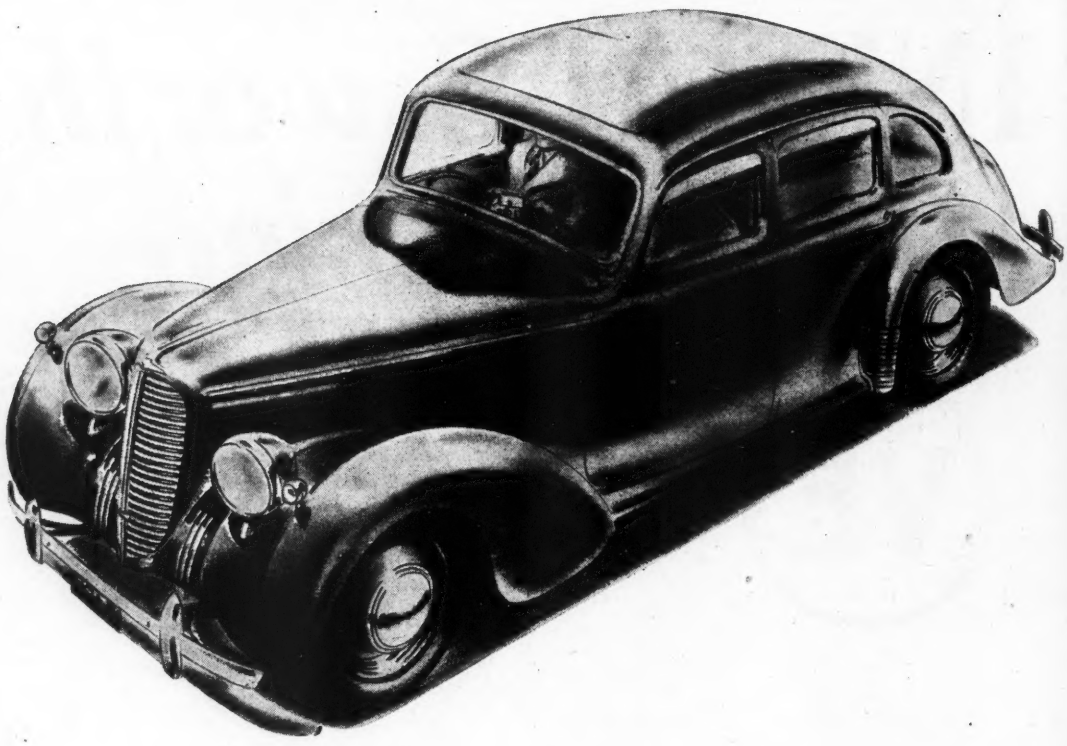
VE VICTORY OVER EUROPE

VJ VICTORY OVER JAPAN

BALL & ROLLER R&M BEARINGS

VICTORY OVER FRICTION

RANSOME & MARLES BEARING CO. LTD NEWARK ON TRENT ENGLAND



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A PRODUCT OF THE ROOTES GROUP

Percival Trainer

New Service Elementary Instructional Type : Three-seat Layout : All-Metal Construction

FOR some time there has been a tendency for the Air Ministry to demand something a little more advanced and "all-purpose" in the way of elementary training types. To this end a specification known as T.23/43 was issued, and the new Percival elementary trainer has been one of the direct results of the efforts made to comply with the features of this specification.

The idea has been to offer an aircraft which would serve to take the pupil a little further along the road of training and to give him his initial experience and instruction in an aircraft with rather more modern characteristics than had previously been considered to be reasonable. Whether or not this policy is sound cannot be discussed here.

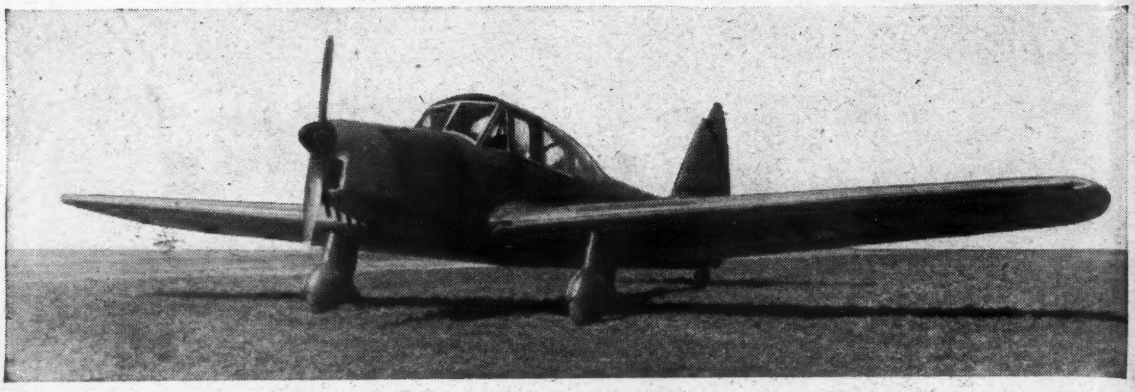
The Percival T.23/43 has accommodation for two pupils in addition to the instructor. While the "primary" pupil is seated in the left of the side-by-side dual seats, the "secondary" pupil is seated alone behind, and is carried merely with the purpose of obtaining preliminary air experience during the particular exercises which are being carried out. He has no controls, but there is full intercommunication so that he, as well as the "primary" pupil, may listen-in to the instructional story. Included in the equipment of the new trainer are the necessary amber filters, covering screen and part of the canopy, designed to provide modern "day-night" synthetic training. These filters are quickly and easily removable while in the air.

Briefly, the T.23/43 is a single-engined low-wing monoplane of all-metal construction and with a fixed undercarriage. The power unit may be either a D.H. Gipsy Queen 32, of 250 h.p., or a Gipsy Queen 51 supercharged engine of 295 h.p., with a constant-speed airscrew in each case.

Details

The structure is simple and fairly conventional. There is no centre-section proper, and the two-spar metal-covered wings, which have detachable tips, are attached directly to the fuselage. The leading and trailing edge portions of the wing are made up as complete units. Between the spars there are main ribs at twenty-inch intervals, with

Unlike previous Percival aircraft the T.23/43 trainer is of all-metal construction. Although it shows "Proctor" ancestry, the actual resemblance is superficial. The arrangement is that of a three-seater, with a "spare" pupil in the single rear seat.

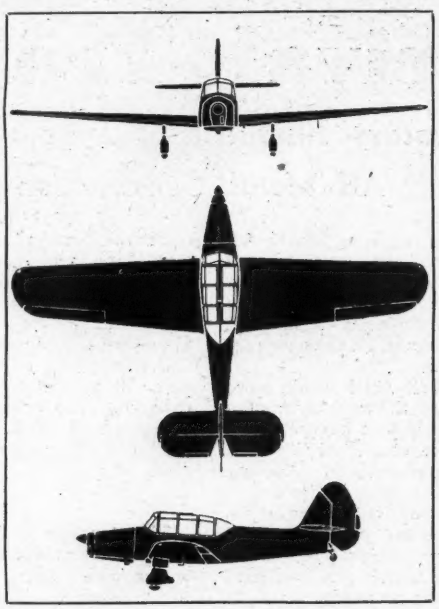


The flat vee-screen and canopy of the T.23/43 is designed to accommodate folding amber filters for "day-night" training. There is a sliding hood for entry on each side of the front cockpit, with an upward sliding door for the rear seat.

PERCIVAL TRAINER (CONTD.)

light former ribs at necessary intervals. Stringers are used only at the root to provide walkway strengthening. The split trailing-edge flaps are in three sections, and run from aileron to aileron, and they are pneumatically operated. There is a gate in the control system to prevent the flaps from being fully retracted when "up" is selected during overshoot action. The ailerons, elevators and rudder are all fabric-covered.

The fuselage can be considered to be in two sections. That forward of the rear bulkhead is almost rectangular in section, and is built up as a partially braced structure with light skin, while the aft portion is of conventional semi-monocoque design. Wing attachments are carried on two built-up girders which also take the seats and control structure, so making up a complete assembly. The entire cabin top, including the windscreen, is also made as a complete unit in order to maintain the necessary guide alignment. From a point aft of the screen structure this unit can be jettisoned as a whole, so that, at the will of the instructor, all three members of the crew may be free to leave the aircraft in an emergency. To deal with the effects of any accidental ground inversion there is a "crash pylon" aft of the front seats. Entry is made through a sliding hood on each side of the forward part of the cabin, with an upward sliding door on the port side for access to the rear seat. The screen panels are of flat safety glass, with direct-vision windows on each side and windscreen wipers.



Control System

Full dual control is, of course, fitted, with the rudder and elevator tab and engine controls properly arranged on the left side of each pilot. Dual brake levers are provided, with the usual differential rudder action, and there is an override lever on the instructor's column to enable him to make the pupil's brake lever temporarily inoperative. The instruments include a standard blind-flying panel. The whole cabin is ventilated and heated. The engine carries vacuum and compressor pumps as well as a generator, and there is an external starting battery plug. The main engine cowlings are hinged along the top line.

Forty gallons of fuel are carried in two crash-proof tanks lying between the spars at the wing roots, where they can be reached through detachable panels on the under-surface of the wing. The four-gallon oil tank is in the port leading edge, with an oil cooler at its inboard end.

PERCIVAL T.23/43

D.H. GIPSY QUEEN 51 SUPERCHARGED ENGINE

DIMENSIONS

Span	46ft 0in
Length	31ft 3in
Track	12ft 0in
Wing area	305 sq ft
All-up weight	3,850 lb

PERFORMANCE

Maximum speed (s.l.)	153 m.p.h.
" " (6,800ft)	171 m.p.h.
Maximum continuous cruising speed (s.l.)	147 m.p.h.
Maximum continuous cruising speed (5,400ft)	160 m.p.h.
Maximum economical speed (s.l.)	129 m.p.h.
Maximum economical speed (12,200ft)	154 m.p.h.
Scalling speed (flaps down)	51 m.p.h.
Maximum rate of climb (s.l.)	1,070 ft./min
Maximum rate of climb (5,000ft)	960ft/min
Service ceiling (approx.)	19,000ft
Run to clear 50ft screen (from grass)	370 yd
Duration (maximum economical cruising at 5,000ft)	3.72 hr (517 miles)

FORTHCOMING EVENTS

April 26th.—Institute of Transport. Lunch and address by Lord Winster. Connaught Rooms. 12.45 p.m.

April 27th.—S.L.A.E. Helicopter Lecture and Film : Manson House, Portland Place, W.1. Speaker : Mr. Raoul Hafner. 3.30 p.m.

May 2nd.—*R.AeS. Graduates' and Students' Section ; "Transport Aircraft," by F. Radcliffe.

May 5th.—S.M.A.E., Midland Competition (petrol models) for the Sir John Shelley Cup.

May 8th.—R.AeS. Reading and Dist. Branch : "The Evolution of Fighter Tactics," by Sqn. Ldr. J. Nelson (Miles Aircraft, Ltd.).

May 24th.—Cambridge U.A.S. 21st Anniversary dinner, University Arms Hotel.

* The Library, 4 Hamilton Place, W.1.

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A civil conversion of the world-famous Oxford, the standard twin-engine trainer of the Royal Air Force, the Consul is produced to meet the demand of business houses for aircraft for executive travel, charter services and feeder lines. Equipped with the remarkably reliable Armstrong Siddeley Cheetah 10 engines (1,250 hours between overhauls) the Consul is economical to operate, reliable in service and has excellent flying characteristics.

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590 miles still-air range, cruising at 165 m.p.h.
Early delivery, £5,500.
Complete except radio.

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Group Captain Wilson A.F.C.
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CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

CARRIER-BORNE TWINS

France's Pre-war Interest

THAT the Mosquito Mark VI fighter-bomber was the first twin-engine machine to land on an aircraft carrier is proudly, and no doubt justly, claimed by de Havillands. It occurs to me, however, that there is just the possibility that the research backing this claim may have overlooked some French activities a year or two before the war. Potez and Dewoitine both designed deck-landing twins for the French Navy (the Potez was a development of the Type 56 light transport), but I have no definite information that either landed on the old *Bearn* for which both were intended. Perhaps a French reader will supply the answer. STICKLER.

THE MASTER CONTROL

U/C Safety Stop in Front Cockpit

REGARDING "Indicator's" article concerning Master aircraft. I have inspected some hundreds of these aircraft, and have yet to see one wherein the undercarriage could normally only be retracted from the front cockpit.

This statement would, of course, be correct if the engine hydraulic pump failed, as the undercarriage hand pump is situated in the front cockpit. H. E. HALL.

["Indicator" replies: "If Mr. Hall tries very hard he will remember that the two undercarriage selector levers in the Master were mechanically inter-connected. Since the safety "stop" was in the front cockpit the lever in the rear cockpit could not be raised without front seat co-operation."]

COCKPIT COMFORT

The Soporific Barracuda

YOUR correspondent, "Pilot, F.A.A.," may be interested to know that I once fell asleep in a Barracuda over Northumberland, thus demonstrating the value of the inherent instability which he mentions. The creature gave a gentle wallow, recalling me to my senses without loss of time or dignity, and far more tactfully than an alarm clock. If the machine had been inherently stable, I might have awakened in Germany.

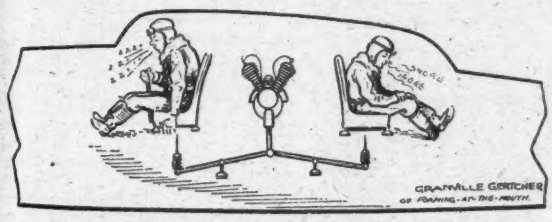
Though short in the leg, I do not find the Barracuda uncomfortable. I think it is its very comfort, and the efficient heating and ventilation, that makes it so soporific. Also, what your correspondent calls the "gentle purring of the engine," which always made me deaf for an hour or two, undoubtedly contributed to the pleasant, dazed feeling which was so inducive to sleep. EX-PILOT, A.T.A.

Patent Applied For ?

HAVING for some time been interested in crew comfort, I was more than a little pleased to read the letter by "Pilot, F.A.A.," in *Flight*, April 4th, and I'm sure it would interest your readers to know that a device for the Prevention of Airborne Slumber is rapidly taking shape.

The enclosed sketch, drawn by Granville, my artistically minded companion, is almost self-explanatory, but as that virtue is practically non-existent I will explain it.

A small engine is installed immediately behind the pilot's starboard rear trouser-button, and incorporates a gear box,



which has something in common with a light wooden piston of laminated matchsticks. To this is connected the actuating arm which is mounted on a cast-iron fulcrum. To the other end is attached the sprung pin of light alloy. This pin is extremely sharp, and from this latter remark the reader will instantly gather the general idea. Cockpit seats will, of course, be standardized with a hole in the appropriate position.

The motor is running throughout the flight, and from time to time the whole business automatically nips gracefully into gear and administers a series of crafty stabs through the holes.

The pins will, of course, be long enough to penetrate a parachute pack, and thus we have the Airborne Awakening.

The whole outfit is simple to install and weighs only 490 lb (originally it weighed 590 lb until our Research Department developed the wooden piston).

Incidentally, this device, which we call the "Auto-Rouser for Dozy Drivers," may well prove to be the turning point in the development of self-sealing pants.

"GROUND-BOUND."

AN N.A.A. MUSEUM

A Permanent Record of Service History

I THINK that the suggestion put forward by your correspondent "Nostalgic" (*Flight*, April 11th), concerning the use of the *Furious* or *Argus* as an N.A.A. museum is an excellent one. The interest shown both by enthusiasts and the general public in things of an aeronautical nature—when they are given a chance to see them—is very great, and a museum of this kind would, I feel sure, be well patronized.

Empire Air Day is an excellent thing, but it is only one day out of 365; let us have something permanent so that we can see not only N.A.A., but also, I hope, R.A.F. history and development at any time we like. E. WATTS.

POST-WAR R.A.F. PAY

"Other Ranks" at a Disadvantage

I WOULD be grateful if you will print the following because so little is said of the airmen's point of view.

When the post-war code of pay for "other ranks" of the Royal Air Force was first published, the aeronautical Press and high officials of the Service took it upon themselves to say how well the O.R.s had been treated and that they were all satisfied. The latter was obviously stated without proof.

Amongst the O.R.s, however, were a considerable number who decided they were not satisfied and who waited for the complaints that would arise from the officers and others if the officer's new pay code was not better than the airmen's.

There was, and still is, much criticism in the Press over the officer's pay code. One point was that the airmen received better treatment than the officers. The airmen fail to see this. The greatest increase for the airmen was amongst the lower ranks, but can it be denied that it was imperative that a substantial increase had to be made on the original figure of 2s or 3s per day that the new entrant received?

Para. 10 of the Airmen's Pay Code estimates that the fully skilled fitter (L.A/C. Group I) receives pay that is, taking into account the different costs of living, equivalent to the civilian pay of £5 10s. Are the skilled fitters of Rootes and Rolls-Royce receiving £5 10s per week?

Para. 28 of the Officer's Pay Code states that substantial increases are made to senior ranks over junior ranks. There is no comparative substantial increase made when an airman becomes a Senior N.C.O. Is the S.N.C.O. fitter receiving pay equivalent to his civilian counterpart, the factory foreman?

Officers are to receive time promotion up to the rank of flight lieutenant. Airmen will soon revert to the pre-war system of the Central Trade Test Board and vacancies, when it was not unusual to go 12 to 16 years for promotion to sergeant.

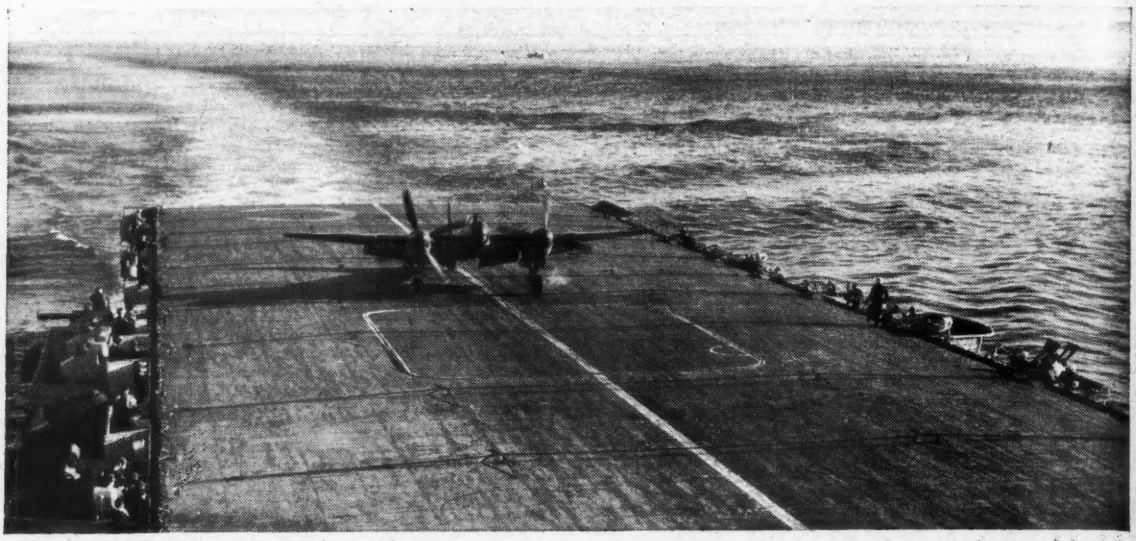
Finally (and most important), the officers are grumbling about their retired pay. The airman is told that he receives a good pension. The facts are that a squadron leader receiving between £675 to £748 per year, will receive retired pay of £475 per year, which is roughly between 60 and 70 per cent. A Sergeant receiving between 94s 6d and 105s per week will receive a pension of the pitiful sum of 36s per week, which is roughly between 34 and 38 per cent.

Can anyone give a justifiable reason why those percentages should differ so greatly between officers and other ranks?

The pension that an airman receives is no reward for service to his country. It barely compensates for the loss of earning power that the airman will suffer after his long absence from civilian life.

There is no shortage of applicants for permanent commissions. There is a shortage of airmen who are willing to re-engage in the regular R.A.F. The papers cannot understand why, but the airmen can! EX-AIRMAN.

SERVICE AVIATION



ON THE *OCEAN:* A D.H. Sea Hornet on the flight deck of H.M.S. *Ocean*, waiting to take off. The Sea Hornet, Sea Vampire and Sea Fury all completed their first carrier trials from the deck of *Ocean*, a 14,000-ton light fleet carrier.

Royal Air Force and Naval Air Arm News and Announcements

New Wing

AS a result of the reorganization of R.A.F. Transport Command, No. 45 Group in Canada has been reduced in status and has now been renamed No. 45 Wing, and is commanded by Group Capt. D. W. Bonham Carter, D.F.C.

Victory Parade, June 8th

ROYAL AIR FORCE and Naval squadrons will fly over London in formation as part of the Victory Parade on Saturday, June 8th, 1946.

The fly-past will include Beaufighters, Lancasters, Meteors, Mosquitoes, Spitfires and Sunderlands, and the Royal Navy will be represented by Firebrands, Seafires and Sea Mosquitoes.

Squadrons will rendezvous at a point east of London and fly over the saluting base, from Admiralty Arch to Buckingham Palace, from twelve noon to 12.20 p m with short intervals between squadrons.

The R.A.F. contingent will be provided by Bomber, Coastal and Fighter Commands and by British Air Forces of Occupation Germany.

A.T.C. cadets will *not* take part in the parade. Replying to Sir Wavell Wakefield in the House of Commons on behalf of the Under Secretary of State for Air, Mr. Ivor Thomas said that, as the parade would be very fatiguing for young cadets, it had been arranged that they would not be represented in the Victory march itself, but space had been reserved for cadet organizations, including the A.T.C., at a very prominent point on the route, namely, at the Victoria Memorial.

Although this decision has, no doubt, been taken after discussion with the A.T.C. leaders, we feel that it is a very disappointing one for thousands of cadets.

Awards

Royal Air Force

THE KING has been graciously pleased to approve the following award:—

Distinguished Service Order

Act. Wing Cdr. A. D. GROOM, R.A.F., H.Q., 49th Indian Infantry Brigade.—During the period October 27th to October 31st, 1945, Wing Cdr. Groom was working with the 49th Indian Infantry Brigade at Sourabaya, Java. Throughout this period the city was in the hands of an uncontrolled mob who, with Indonesian forces, launched continual and fanatical attacks against points held by detachments of Indian troops. The fighting was very bitter and lone men, or small parties making their way to safety, were butchered under circumstances of the utmost barbarity; British officers were dragged from their cars and murdered. Wing Cdr. Groom, in view of his personal knowledge of the Indonesian leaders, their language and acquaintance with the freedom movement, volunteered to act as Liaison Officer. He completely ignored the extreme danger to his life, moving unarmed from area to area in which fighting was taking place and parleying with the frenzied mobs and their irresponsible leaders. Wing Cdr. Groom was threatened, abused and man-handled yet, despite fatigue, he continued unsparingly for 36 hours in his attempts to stop the attacks on our troops. By his efforts a number of engagements were brought to a close, and the movements of small bodies of troops to greater safety was successfully arranged. Wing Cdr. Groom afforded inestimable help to the Brigade Commander. By his sustained gallantry and resolution he saved many lives and set an example that was an inspiration to all.

THE King has been graciously pleased to approve the following awards in recognition of gallantry and devotion to duty in the execution of air operations.

Distinguished Flying Cross

Act. Sqn. Ldr. H. A. JENKINS, R.A.F., No. 215 Sqn.
Flt. Lt. H. S. BEARD, R.A.F.V.R., No. 215 Sqn.
Flt. Lt. E. F. BROWN, R.A.F.V.R., No. 215 Sqn.
Flt. Lt. J. S. HARTLEY, R.A.F.V.R., No. 117 Sqn.
Flt. Lt. I. C. MCLENNAN, R.A.F.V.R., No. 215 Sqn.
Flt. Lt. A. W. ROBERTS, R.A.F.V.R., No. 215 Sqn.
F/O W. L. H. GREENWOOD, R.A.F.V.R., No. 117 Sqn.
F/O. N. L. RILEY, R.A.F.V.R., No. 117 Sqn.
W/O. A. C. COOMBE, R.A.F.V.R., No. 215 Sqn.
W/O. W. J. DARK, R.A.F., No. 267 Sqn.
W/O. M. J. FFOLLIOTT-FOSTER, R.A.F.V.R., No. 215 Sqn.
W/O. R. H. HEAWOOD, R.A.F.V.R., No. 215 Sqn.
W/O. C. HIRST, R.A.F.V.R., No. 117 Sqn.
Flt. Lt. R. S. MINCHIN, R.A.A.F., No. 117 Sqn.
Act. Flt. Lt. R. ORDELL, R.A.A.F., No. 100 Sqn.
Sqn. Ldr. R. J. CLEMENT, R.C.A.F., No. 435 (R.C.A.F.) Sqn.
Act. Sqn. Ldr. D. R. H. RUE, R.C.A.F., No. 435 (R.C.A.F.) Sqn.
Flt. Lt. J. GRANT, R.C.A.F., No. 117 Sqn.
Flt. Lt. L. C. HEMPSALL, R.C.A.F., No. 435 (R.C.A.F.) Sqn.
Flt. Lt. W. S. ROBERTSON, R.C.A F., No. 436 (R.C.A.F.) Sqn.
Flt. Lt. A. W. ROGERS, R.C.A.F., No. 117 Sqn.
Flt. Lt. T. A. SALO, R.C.A.F., No. 435 (R.C.A.F.) Sqn.
F/O. J. E. D. BOYD, R.C.A.F., No. 117 Sqn.
F/O. A. H. HUTCHINSON, R.C.A.F., No. 435 (R.C.A.F.) Sqn.
F/O. M. W. LITTLE, R.C.A.F., No. 117 Sqn.
Flt. Lt. A. C. POPE, R.A.F.V.R., No. 156 Sqn.
Flt. Lt. L. W. ROWLEY, D.F.M., R.A.F.V.R., No. 99 Sqn.
Flt. Lt. D. S. SCOFFHAM, R.A.F.V.R., No. 11 Sqn.
Act. Flt. Lt. D. L. VENNING, R.A.F.V.R., No. 635 Sqn.
F/O. L. A. COX, R.A.F.V.R., No. 156 Sqn.
F/O. G. DACK, R.A.F., No. 11 Sqn.
F/O. A. V. NAYLOR, R.A.F.V.R., No. 81 Sqn.
P/O. J. G. GIPSON, R.A.F.V.R., No. 99 Sqn.

Conspicuous Gallantry Medal (Flying)

Sgt. (now W/O.) P. A. HILTON, R.A.F.V.R., No. 35 Sqn.—Sgt. Hilton was pilot and captain of an aircraft detailed for a night operation in June, 1942. While over enemy territory, his aircraft was attacked by three enemy fighters. As a result, the aircraft sustained serious damage and three engines were put out of action. Sgt. Hilton gave the order to abandon aircraft; this order was obeyed by all members of the crew, with the exception of the flight engineer, whose parachute had become unserviceable. Sgt. Hilton showed that his first thought was for the safety of his crew, and although he knew it meant almost certain death, he gave his own parachute to the flight engineer, who thus was enabled to leave the badly damaged aircraft. With great courage and gallantry, Sgt. Hilton then attempted to make a forced landing. He was thrown clear of the crashed aircraft, which caught fire. Subsequently he was taken prisoner of war. Sgt. Hilton displayed outstanding courage and coolness in the face of great danger. His complete disregard for his own safety, in order to save the life of one of his crew, showed a devotion to duty worthy of the highest praise.

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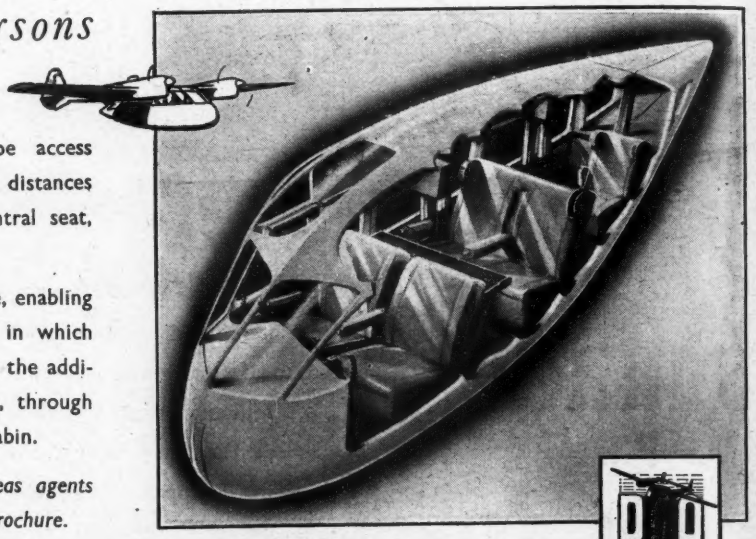

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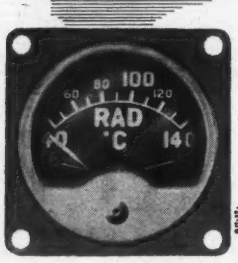

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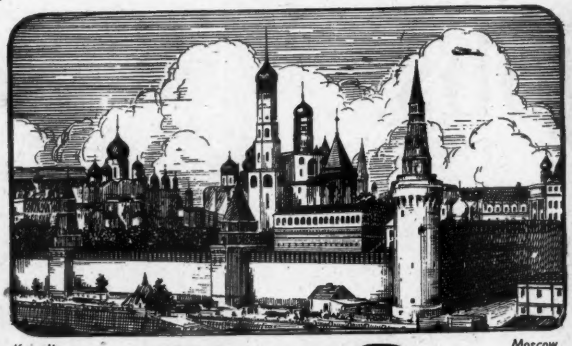

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Roll of Honour

Casualty Communique No. 572.

THE Air Ministry regrets to announce the following casualties on various dates. The next of kin have been informed. Casualties "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

Of the names in this list 236 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Sgt. R. T. Bell; F/O. J. Calland; Flt. Sgt. D. U. Cameron; Sgt. J. Cowe; Act. Sqn. Ldr. G. A. De Souza; Sgt. L. Helsby; F/O. B. Hill; Sgt. H. G. Lake; Act. Wing Cdr. J. B. Nicolson, V.C., D.F.C.; Sgt. D. S. Smith; P/O. J. Spillard.

MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. A. J. Moore.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. H. E. Browne; P/O. C. W. Culling; W/O. D. Galbraith; Sgt. G. J. Harris; Sgt. B. Jones; Flt. Lt. L. V. King; Flt. Sgt. W. Longmore; Sgt. W. McCabrey; Flt. Sgt. E. P. Pope; Sgt. E. E. Pope, Flt. Sgt. G. C. Telfer; Sgt. V. Williams; Sgt. J. Wilson.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. R. J. Adams; Sgt. S. J. Akhurst; Sgt. S. W. Allen; P/O. P. S. G. Apperley; Sgt P. Baguley; Act. Flt. Lt. R. Banks; Sgt. R. G. Barker; Sgt. G. Barnes; P/O. A. H. Barton; Sgt. T. Barton; Flt. Sgt. L. F. Beattie; Flt. Sgt. J. Beecroft; Sgt. M. T. Bird; Sgt. R. A. O. Blanchard; Sgt. H. Bodger; Flt. Sgt. H. E. Bolt; Flt. Sgt. K. C. Bottle; W/O. J. H. Bradburn; Sgt. A. J. Bramble; P/O. W. E. Bransgrove; Flt. Lt. G. Butterfield, D.F.M.; Sgt. J. P. Callan; F/O. J. W. Christopherson; Sgt. J. F. Cleary; Flt. Sgt. D. Clisby; F/O. R. E. W. Colgate; P/O. A. C. L. Cox; Flt. Sgt. D. Crerar; Act. F/O. E. Dalgleish; Sgt. W. Damen; W/O. D. A. Denton; Sgt. R. C. Dickin; P/O. R. L. Dodds; Sgt. E. R. Dore; F/O. W. G. Driscoll; Flt. Sgt. A. Easton; Flt. Lt. G. B. Eccles, A.F.C.; P/O. G. J. Edwards; Flt. Sgt. J. A. Evans; Sgt. W. J. Faulkner; Sgt. A. J. Ford; Flt. Sgt T. J. Foy; Flt. Sgt. N. E. Freshwater; Sgt. W. G. C. Garner; Sgt. C. W. Garrett; Sgt. J. O. Gibson; Sgt. J. Gilfillian; Sgt. C. F. Gill; Sgt. J. J. Gough; P/O. J. Graham; F/O. J. A. Grey; Sgt. J. Grice; Flt. Sgt. G. G. Griffin; Sgt. A. H. Griffiths; Flt. Sgt. P. M. Griffiths; Sgt. G. T. Hagues; Flt. Sgt. R. H. Hall; F/O. A. E. Halliwell; Flt. Sgt. C. A. Hammond; Flt. Sgt. L. A. Harding; Sgt. E. Harwood; Sgt. E. M. Hayward; Sgt. H. W. Hazell; Flt. Sgt. A. D. Heggison; Sgt. C. Hemingway; F/O. P. N. Hemy; Sgt. R. Hewitt; Flt. Sgt. R. J. Holland; Flt. Lt. F. H. Holmes; Sgt. T. N. Howe; W/O. D. T. Hughes; Sgt. F. W. L. Hunwick; Sgt. E. Hurst; Flt. Sgt. E. H. Jenkins; F/O. A. L. Johnston; Flt. Lt. E. R. Jones; Flt. Sgt. D. V. Joy; Sgt. K. Kay; Flt. Lt. H. B. Kelly; F/O. J. A. Kennedy, D.F.C.; Sgt. S. T. Kerr; Sgt. R. Kilner; Flt. Sgt. A. J. Kimberley; P/O. C. F. Kirby; Flt. Sgt. E. G. Lambert; Flt. Sgt. W. D. Leavesley; W/O. A. G. Lewis; Sgt. D. W. Lillicrap; P/O. H. Lyndon-Adams; W/O. G. E. Lythgoe; Sgt. R. D. McAdam; Sgt. R. W. McCormick; F/O. J. W. McDonald; P/O. M. MacDonald, D.F.C.; Sgt. A. McDonnell; Sgt. J. G. McEwan; Sgt. J. McFarlane; Sgt. J. A. J. M. McGhie; Group Capt. W. N. McKechnie, G.C.; Sgt. M. McKenzie; Sgt. T. H. MacLean; Flt. Sgt. J. S. MacNee; Sgt. J. McNee; Sgt. D. H. Malcolm-Jones; Sgt. C. Manley; Sgt. J. Manson; Act. F/O. A. J. Marshall; Sgt. M. P. Mary; P/O. A. C. Mathews, D.F.C.; Sgt. W. H. Meager; Sgt. D. Menzies; W/O. D. C. Moore; Flt. Sgt. C. W. Morley; Sgt. G. Morrison; Flt. Sgt. C. G. Morton; Sgt. W. E. C. Mount; Sgt. R. W. Nanson; F/O. W. Nixon; Flt. Sgt. W. Nixon; P/O S. W. Oman; Flt. Sgt. S. Ormondroyd; Flt. Lt. D. C. Paterson; P/O. R. Pickles; Flt. Sgt. K. H. Pithouse; Sgt. J. D. Potter; Sgt. J. Powell; Sgt. R. J. Price; Sgt. T. J. Prince; F/O. E. W. Rawlins; Sgt. S. C. Rennie; F/O. A. F. Reynolds; Sgt. T. G. Reynolds; P/O. F. W. Rogers; Sgt. J. Rogers; Flt. Lt. G. Russell, D.F.C.; Sgt. J. Scaife; Flt. Sgt. R. W. Small; W/O. F. Smith; F/O. F. J. Smith; Flt. Sgt. G. B. Smith; Sgt. T. J. R. Smith; Sgt. N. Soulsby; Sgt. J. B. Sowden; Sgt. S. Stanton; F/O. J. E. Stevens; Flt. Sgt. W. H. Swingler; F/O. E. C. Tebb; F/O. W. L. Thacker; Sgt. J. Thornley; Flt. Sgt. H. Thornton; Sgt. A. C. L. Todd; Flt. Sgt. J. E. Tooth; W/O. E. R. Trumper; F/O. E. T. Tunstall; P/O. H. M. J. Vere-Hodge; F/O. G. D. Warburton; Flt. Sgt. R. F. Wardle; F/O. F. T. Watson, D.F.M.; Flt. Sgt. J. H. Watson; Sgt. B. F. Webb; Act. Flt. Lt. D. W. Webber, D.F.C.; F/O. C. B. Whitmore; Sgt. J. G. C. Whitworth; P/O. A. A. Wiggins; Flt. Lt. W. E. Wilbur; Flt. Lt. E. L. Wilde; Flt. Sgt. V. L. Wilkinson; Act. Flt. Lt. D. G. Williams, D.F.C.; Flt. Lt. R. A. Willis; P/O. R. J. Winchester; Flt. Sgt. L. G. Wood; Flt. Sgt. D. W. Wright; F/O. J. Yeoman; Sgt. H. I. York; Sgt. M. Young; F/O. N. F. Young; Sgt. H. A. N. Yule.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—Sgt. F. W. Clinch; Sgt. D. Cox; Sgt. E. R. Edwards; Sgt. J. McD. Kerr; Flt. Lt. H. Y. Lao; Sgt. J. Manning; Sgt. D. Morris; Flt. Lt. J. Summers; Act. Group Capt. W. E. Surplice, D.S.O., D.F.C.

MISSING.—Flt. Sgt. J. F. D. Churchill; Sgt. R. K. Grainger; P/O. E. J. Greenway; Sgt. F. H. H. Marchant; Flt. Lt. T. L. Mumby, D.F.M.; W/O. K. C. Pickering; F/O. J. V. Prouser.

KILLED ON ACTIVE SERVICE.—Sgt. P. J. Ashton; W/O. L. R. Blackwell; F/O. A. N. Borrow; Sgt. P. Bosworth; P/O. D. Bradley; Sgt. W. Bradshaw; P/O. L. A. Bridgman; Flt. Sgt. F. B. Brindley; W/O. S. V. D. Brown; F/O. W. E. Cornock; Flt. Lt. S. B. Dalmais; Flt. Lt. A. E. Dowling; F/O. R. H. E. Dunsford; P/O. J. G. Eaton; F/O. P. Ettlinger; W/O. W. J. Evans; W/O. P. J. N. Eve; Flt. Lt. F. J. French; Flt. Sgt. O. W. Geeson; F/O. A. Herbert; Act. Sqn. Ldr. F. P. A. Heynert, D.F.C.; Flt. Sgt. T. A. Holmes; Sgt. G. E. A. Hulbert; L.A/C. J. D. Main; F/O. R. S. Manson; Sgt. J. Milne; Flt. Sgt. S. Newton; A/C.1 G. W. Paffey; Sgt. S. Rickards; W/O. W. J. Smart; F/O. P. H. A. Smith; Sgt. J. M. Tallentire; W/O. D. A. Tuffield; Flt Lt. S. W. Wells; Sgt. T. Veitch; Sgt. R. L. Williams; Flt. Sgt. W. R. G. Wood.

MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Flt. Sgt. F. R. Ley; Flt. Sgt. H. L. Seabrook.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.—Sgt. H. Burton; Sgt. V. W. Clarke; F/O. H. C. Grundey, D.F.M.; Flt. Sgt. S. Hall; Flt. Sgt. F. C. Hatcher; Sgt. C. C. Kellaway; Sgt. G. M. McDonnell; Sgt G. C. McNicol; Sgt. E. V. Norris; Sgt. L. N. Penn.

WOUNDED OR INJURED ON ACTIVE SERVICE.—A/C.1 R. Evans; F/O. A. R. Hastewell; Sgt. W. H. Mander; Flt Sgt. E. Vickers; Flt. Lt. D. K. Waters.

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—Sgt. R. D. Frost; Sgt. F. Johnson.

DIED ON ACTIVE SERVICE.—L.A/C. L. Burgess; L.A/C. K. J. Burnett; L.A/C. L. Clarke; W/O. E. W. C. Corsie; L.A/C. W. Emerson; L.A/C. H. Evans; L.A/C. J. F. R. Forrest; A/C.2 J. B. Furniss; L.A/O. J. R. M. Hall; Sgt. R. Harnwell; Flt. Lt. R. J. Harris; Sgt. J. E. Ince; A/C.2 W. C. Johnson; Cpl. G. G. Jordan; L.A/C. F. Lane; Cpl. G. Lane; A/C.1 C. H. P. Mabey; Act. Cpl. A. R. Munnoch; Sgt. A. Newton; L.A/C. J. G. Parfitt; L.A/C. L. W. Robinson; L.A/C. R. B. Rowe; L.A/C. R. J. Scott; Cpl. D.A. H. Sheppard; Cpl. H. W. Stanley; L.A/C. W. J. C. Tate; L.A/C. A. J. Taylor; Act. Wing Cdr. B. M. Thompson; L.A/C. J. D. Walker.

Women's Auxiliary Air Force

DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.—L.A/CW. L. S. Bankier.

DIED ON ACTIVE SERVICE.—L.A/CW. E. V. M. Robson; L.A/CW. H. M. Thompson.

Royal Australian Air Force

MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—P/O. W. F. Blackford; W/O. G. E. Longland; Flt. Sgt. E. C. Nayda; W/O. J. G. Shearer.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—Flt. Lt. R. A. Hast.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Flt. Sgt. J. A. Adams; Flt. Sgt. E. J. Anderson; Flt. Sgt. W. R. Andrew; P/O. F. R. Burrows; W/O. W. J. Carrier; Flt. Lt. J. D. R. B. Carruthers; Flt. Sgt. E. G. Challis; P/O. J. H. N. Cleminson; Act. F/O. K. I. Cole; Flt. Sgt. W. S. Crober; Flt. Sgt. J. McK. Dillon; Flt. Sgt. E. J. Freame; P/O. H. Hale; Flt. Sgt. K. K. Kempson; Flt. Sgt. M. J. Mahar; Flt. Sgt. M. W. Marsh; Flt Sgt. K. A. Martin; Flt. Lt. F. D. Moffitt; Flt Sgt. J. W. A. Montgomery; Flt. Sgt. J. W Powell; Act. F/O. W. P. Quan; Flt. Sgt. E. J. Ryan; P/O. A. S. Williams.

MISSING.—Flt. Sgt. K. T. Cook; Flt. Lt. C. R. H. Elmes; Flt. Sgt. H. B. Francis; F/O G. H. Glasgow; Flt. Sgt. C. H. Hamilton; P/O. G. C. O. Pollie; P/O. W. Vaughan.

KILLED ON ACTIVE SERVICE.—Sqn. Ldr. J. S. McGoldrick.

DIED ON ACTIVE SERVICE.—W/O. L. J. Allen.

Royal Canadian Air Force

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—P/O. W. R. Dauphin; F/O. R. A. Thorne.

R.A.F. WAR COMMANDERS

Air Marshal Sir W. Alec Coryton

AIR MARSHAL SIR WILLIAM ALEC CORYTON, K.B.E., C.B., M.V.O., D.F.C., is Controller of Aircraft Supplies to the Ministry of Supply, and, as such, is a member of the Air Council. With the centralization in that Ministry of all aviation research and development, Sir Alec's task is by no means an enviable one. He should, however, be well fitted for it by virtue of his long and wide service experience both at home and overseas.

He was educated at Eton and King's College, Cambridge, but left the latter to take a commission as a 2nd Lt. in the 8th (Service) Battalion of the Rifle Brigade in September, 1914. He transferred to the Royal Air Force when it was formed in 1918. In 1920 he became a flying instructor at the R.A.F. College and, later the same year, was posted to No. 31 Squadron in India. He was awarded the D.F.C. in 1922 for his services in Waziristan. Coryton remained in India for a considerable period, and from 1925 until 1931 was at the School of Army Co-operation, becoming for a time its Chief Instructor.

When he returned to this country, he held Air Staff posts, first at Air Ministry and then at Headquarters, Coastal Area. In 1935 he was again posted overseas, this time to Headquarters, Iraq, to undertake special duties at Mosul. In 1937, he completed a course at the Royal Naval Staff College at Greenwich.

Upon the outbreak of war, Coryton became Director of Operations (Overseas) at Air Ministry with the rank of Air Commodore, and he continued in this post during the critical early years of the war until, in 1942, he was given the command of No. 5 Group, Bomber Command. In 1943, he went out to Headquarters, R.A.F., Middle East, as Senior Air Staff Officer with the rank of Air Vice-Marshal, but later that year was brought back to join Air Ministry Air Staff once again, this time as Assistant Chief of Air Staff (Operations).

In August, 1942, he was granted the rank of Air Marshal and the command of 3rd Tactical Air Force, Air Command, South-East Asia, and in January last year became Assistant Air Commander to the East Air Command, South-East Asia, an appointment which carried with it the command of the Royal Air Force in Bengal and Burma. Later in the year, at the age of 50, Sir Alec was again brought back to this country to take over the post of Controller of Research and Development at M.A.P.

SERVICE AVIATION

KILLED ON ACTIVE SERVICE.—F/O. E. J. McCabe.

DIED ON ACTIVE SERVICE.—Cpl. G. W. Beatty.

Royal New Zealand Air Force

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. R. P. McNabb.

KILLED ON ACTIVE SERVICE.—P/O. R. M. Bullen, D.F.C.

South African Air Force

KILLED ON ACTIVE SERVICE.—Lt. W. D. Blom; Capt. G. H. Edwards; Lt. R. D Park; Lt. R. H. Templer.

DIED ON ACTIVE SERVICE.—Air Mech. A. E. D. Grundling.

Royal Indian Air Force

KILLED ON ACTIVE SERVICE.—A/C.2 P. V. Mathai.

Casualty Communiqué No. 574

Of the names in this list, 250 are second entries giving later information of casualties published in earlier lists.

Royal Air Force

KILLED IN ACTION.—Flt. Lt. D. S. Park.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.—F/O. W. Davies; Flt. Lt. A. Elliott; F/O. R. W. Walker-Lutz.

PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.—Sgt. A. R. Albery; W/O. W. H. Aldridge; Sgt. G. F. J. Anstee; P/O. A. Astle, D.F.C.; F/O. T. M. C. Ball; F/O. A. F. Ballantyne; Sgt. W. A. Berry; F/O. E. Bourton; Flt. Sgt. E. A. Bradshaw; W/O. F. P. W. Bray; Flt. Sgt. R. C. Bray; Flt. Sgt. J. T. Broad; Flt. Sergt. J. G. Brown; Flt. Sgt. E. O. Bule; Sgt. G. B. Byrne; F/O. D. L. S. Cameron; P/O. J. S. Cameron; F/O. G. E. Cansell; F/O. P. F. Carlisle; F/O. H. G. Chapman; Flt. Sgt. D. F. Cook; F/O. H. S. Cook; Sgt. S. J. Cooke; Flt. Sgt. F. Crompton; Flt. Sgt. S. W. G. Currigan; Sgt. T. F. Darragh; Sgt. W. E. Davies; Sgt. A. Dawson; Act. Flt. Lt. K. P. C. Doyle, D.F.C.; Act. Flt. Lt. A. Drinkall; W/O. W. H. Edinburgh; Sgt. W. S. Edwards; Sgt. A. J. Elworthy; F/O. N. Evans; Sgt. T. Fenwick, Sgt. E. Finney; Flt. Lt. D. R. O Ford, D.F.C.; Sgt. C. L. Foster; W/O. K. D. Fox; Sgt. J. A. Gillett; Flt. Sgt. D. K. Green; W/O. C. H. Gunby; P/O. D. G. Hardy; Sgt. J. J. Harris; F/O. F. F. Hebditch; Sgt. H. W. Hesketh; Sgt. G. Hogg; W/O. E. Hopkins; Sgt. S. Horder; Flt. Sgt. W. R. Hoyle; Flt. Sgt. T. J. Hurdiss; Sgt. N. Hustwaite; W/O. L. Irving; F/O. C. F. Jelley, D.F.C.; Sgt. R. C. R. Johnson; Sgt. E. F. Keen; Flt. Sgt. S. G. Kentch; Act. F/O. T. E. Kerslake; W/O. W. E. Kinsey; Sqn. Ldr. R. T. Langton, D.F.M.; Sgt. A. Ledger; Flt. Sgt. N. J. Lees; W/O. W. G. Lewis; Flt. Lt. J. S. Limbert; Sgt. F. Longbottom; Flt. Lt. D. S. Lord, D.F.C.; Flt. Lt. W. S. Lough; Sgt. C. McGarry; Flt. Sgt. E. McQuire; W/O. G. J. Manlow; Sgt. J. W. Marshall; Sgt. S. Marshall; F/O. F. Marwood; Sgt. L. K. Matthews; Sgt. V. I. Michael; Sgt. A. Moir; Sgt. J. R. Moody; Sgt. J. I. Morgan; F/O. H. F. Morrish; F/O. J. E. G. Muschamp; Sgt. R. B. Newton; Sgt. J. O'Donnell; Sgt. F. G. Owen; F/O. I. G. Owen; Sgt. R. J. Parsons; Sgt. B. J. Peverelle; Flt. Sgt. D. H. R. Plear; P/O. O. H. Pollard; P/O. W. R. Pring; Sgt. W. L. Pryce; Sgt. D. W. Rawson; Sgt. S. O. Reneau; Sgt. K. C. Richards; Sgt. J. E. Richardson; Flt. Sgt. B. L. Roberts; Sgt. W. H. H. Matthews; Sgt. D. W. Roberts; Flt. Sgt. W. J. Roberts; Sgt P. A. Rose; Flt. Sgt. H. R. Scarr; Sgt. P. J. Sheehy; F/O. G. O. B. Sinclair; Sgt. H. E. Smith; Sgt. K. Steele; Flt. Lt. J. L. Storer; P/O. S. I. Taylor; F/O. P. E. Thompson, D.F.C.; Sgt. B. C. R. Tomlinson; F/O. F. P. Trautman; Flt. Sgt. B. J. Tuhey; Flt. Sgt. R. F. Veness; Sgt. R. F. Vicary; Sgt. T. Vickers; Sgt. W. B. Walker; F/O. W. B. Wardle; P/O. R. Webb; Flt. Lt. H. West; Sgt. R. Whybrow; Flt. Sgt. C. Wilshaw; Sgt. H. J. Woods; Sgt. J. Woolley; Sgt. S. Wright; Sgt. W. J. C. Wylie.

PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW REPORTED KILLED IN ACTION.—Sgt. J. R. Frehner.

PREVIOUSLY REPORTED MISSING, NOW REPORTED KILLED IN ACTION.—F/O. K. A. Ayres, D.F.C.; Sgt. R. B. Bond; Sgt. A. G. Evans; Flt. Sgt. D. Head; F/O. W. C. Heath; Sgt. W. C. Taylor; Flt. Sgt. R. Zambra.

WOUNDED OR INJURED IN ACTION.—Flt. Lt. P. Arkell.

MISSING.—Flt. Sgt. J. Blakey; Flt. Sgt. W. H. S. Brash; F/O. J. T. Bromfield; P/O. A. W. Coventon; F/O. W. K. Dovey; W/O. J. A. Edwards; F/O. E. D. Mason; Sgt. K. B. Mulligan; Flt. Sgt. W. Ross; Flt. Lt. J. B. Stephen; Flt. Sgt. R. A. Towell; Flt. Sgt. A. Turner; F/O. J. S. Watts.

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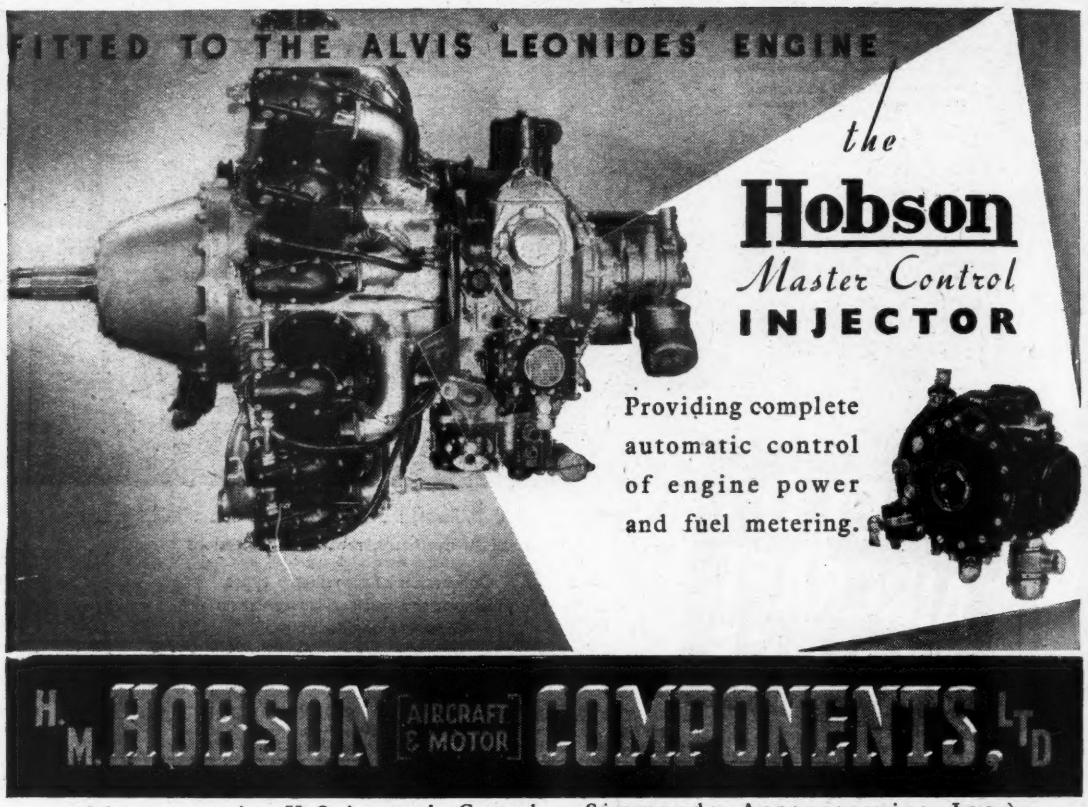
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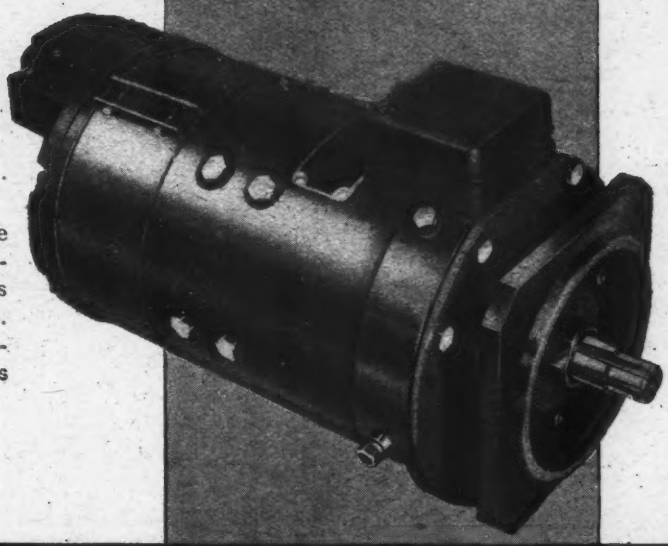

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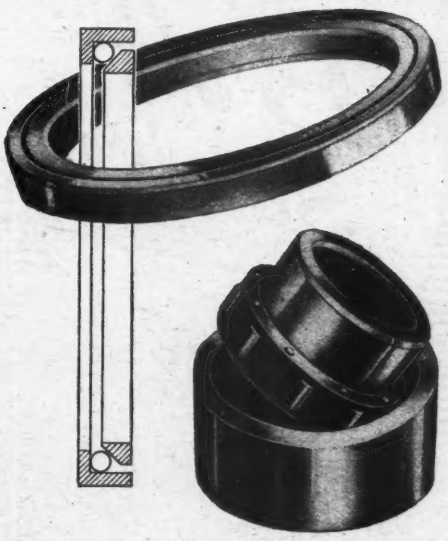

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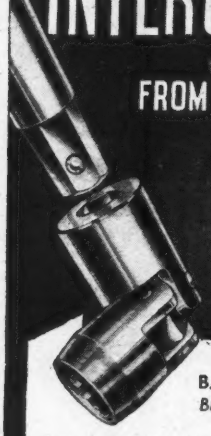

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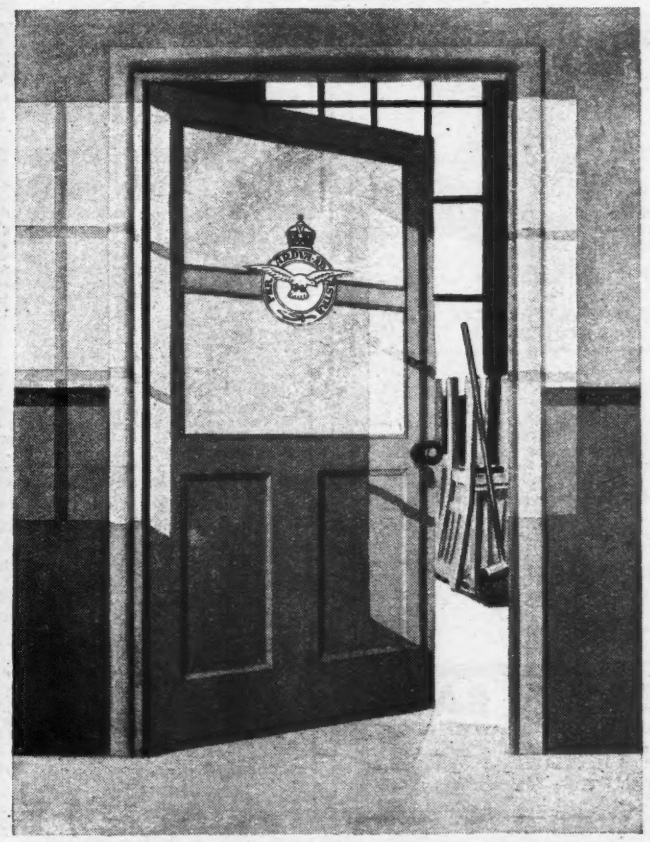

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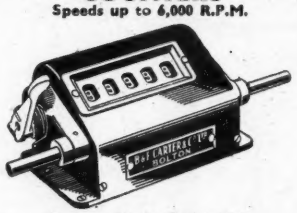

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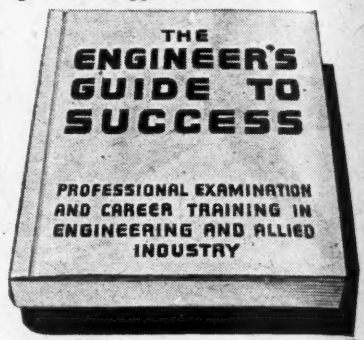

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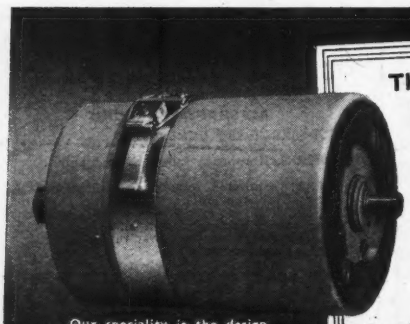

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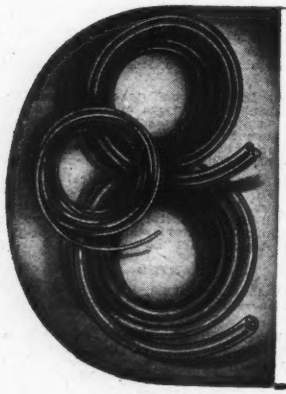

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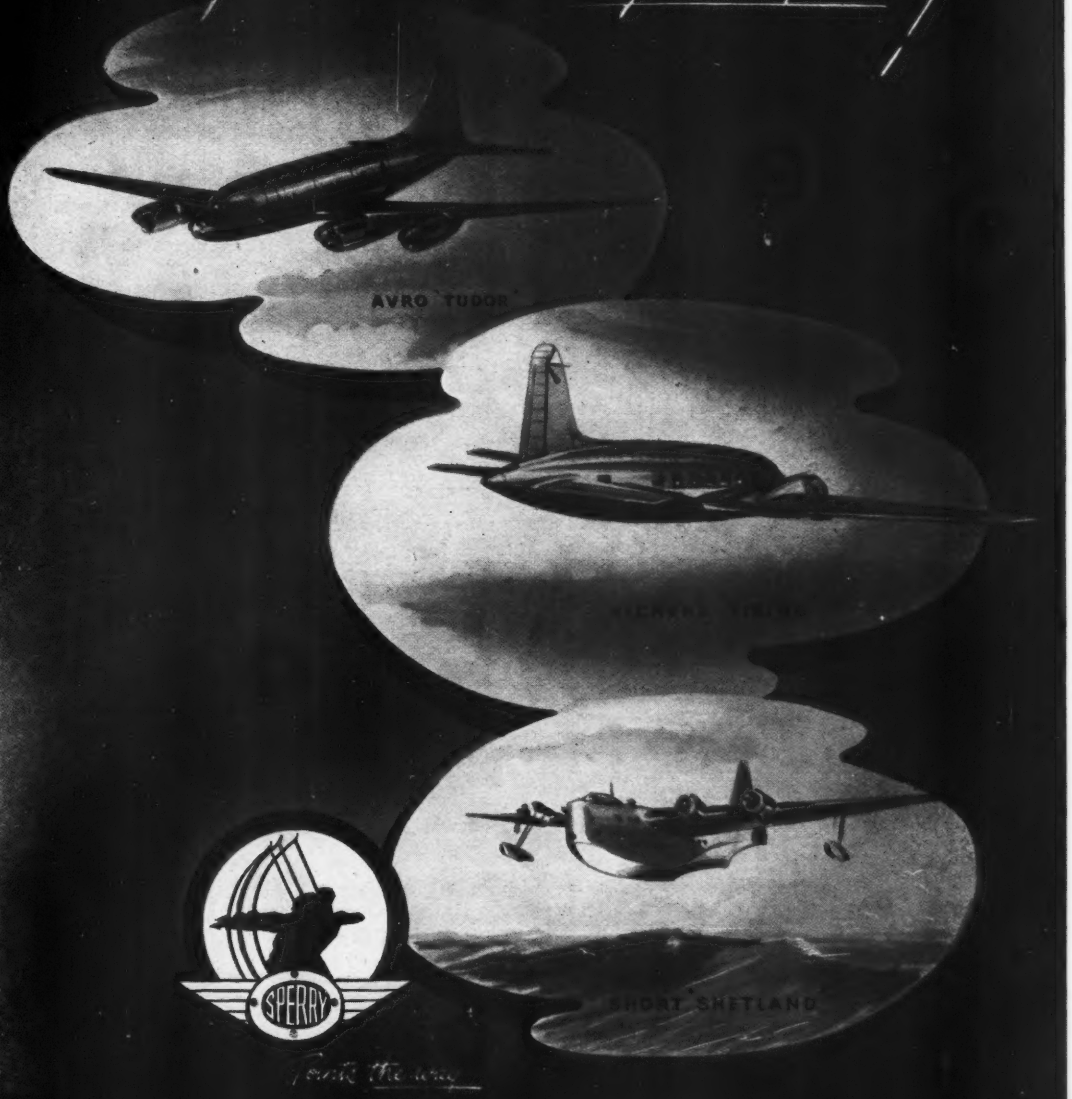

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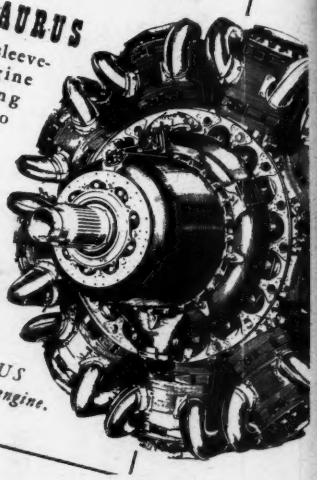

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